A STUDY TO EVALUATE MAGNESIUM SULPHATE IN ACCELERATING THE ONSET OF ACTION OF INJECTION BUPIVACAINE USED FOR EPIDURAL ANAESTHESIA

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MADRAS MEDICAL COLLEGE

CHENNAI- 600 003

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CERTIFICATE

This is to certify that the dissertation entitled, **" STUDY TO EVALUATE MAGNESIUM SULPHATE IN ACCELERATING THE ONSET OF ACTION OF INJECTION BUPIVACAINE USED FOR EPIDURAL ANAESTHESIA"** Submitted by Dr.S.MANOJ KUMAR in partial fulfilment for the award of the degree of Doctor of Medicine in Anaesthesiology by the Tamilnadu Dr. M.G.R. Medical University, Chennai is a bonafide record of the work done by him in the INSTITUTE OF ANAESTHESIOLOGY & CRITICAL CARE, Madras Medical College, during the academic year 2009-2012.

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CONTENTS

INTRODUCTION

Jean Athanase Sicard and Fernand Cathelin independently introduced cocaine through sacral hiatus in 1901, thereby becoming the first practitioners of caudal (epidural) anesthesia.

Twenty years later, Fidel Pages described the interspinous approach to the epidural space and reported satisfactory anesthesia for intra-abdominal procedures. In 1945, Tuohy introduced the epidural needle but it was Eugene Aburel who introduced a silk ureteral catheter in the epidural space and used it to block the pain of labor in women. By 1962, the first polyvinyl catheter with a closed tip was introduced, making the continuous epidural block much easier to perform in an efficient way.

Epidural blockade[2] has a unique special feature of segmental blockade where by only the desired segments required for surgical plane are blocked, unlike the uncontrolled level of blockade as occurs in spinal anesthesia. The period of analgesia can be extended to the post-operative period through the continuous catheters.

Ever since the administration of local anesthetics in epidural route, there has been many adjuvants (adrenaline, opioids, alpha-2 agonists, ketamine,

neostigmine) that are added to shorten the onset of action, improve the quality of analgesia and prolong the duration of analgesia in the post-operative period.

Magnesium sulphate has been added as an adjuvant in neuraxial blockade. It has been known to possess anti-nociceptic property in intravenous route in the perioperative and the postoperative period. The site of action of magnesium has been explained by the property of NMDA receptor antagonism which has prevented central sensitisation to peripheral nociceptive stimulation. There are many studies to prove its potency as an analgesic. Its clinical efficacy and safety has been proved in humans in experimental studies.

In this Prospective Randomised Double blind controlled study we evaluated the onset of action of magnesium sulphate in epidural anesthesia in patients coming for lower abdominal surgeries.

EPIDURAL NEURAL BLOCKADE

Epidural neural blockade[1, 2] is a type of neuraxial blockade where the improvement in drugs, equipment and technique has made it a popular and versatile technique with its wide applications in surgery, obstetrics and pain medicine. Both single injection and continuous injections with catheters are used.

It is unique in that it can be placed virtually at any level of the spine, allowing more flexibility in its application to clinical practice. It is more versatile than spinal anesthesia, giving the clinician the opportunity to provide anesthesia and analgesia, as well as enabling diagnosis and treatment of chronic disease syndromes.

It can be used to supplement general anesthesia, decreasing the need for deep levels of general anesthesia, therefore providing a more hemodynamically stable operative course and faster emergence from general anesthesia. It provides better postoperative pain control and more rapid recovery from surgery.

ANATOMY [3, 5]

The vertebral column consists of 7 cervical, 12 thoracic, and 5 lumbar vertebrae. At the caudal end, the 5 sacral vertebrae are fused to form the sacrum, and the 4 coccygeal vertebrae are fused to form the coccyx . The primary functions of the vertebral column are to maintain erect posture, to encase and protect the spinal cord, and to provide attachment sites for the muscles responsible for movements of the head and trunk. The normal spinal column is straight when viewed dorsally or ventrally. When viewed from the side, there are two ventrally convex curvatures in the cervical and lumbar regions, giving the spinal column the appearance of a double "C".

The shape and size of the vertebrae differ from the cervical to the lumbar region secondary to function. The vertebral bodies are smaller in the cervical region an become progressively larger in the lumbar area where they support the greatest amount of weight.

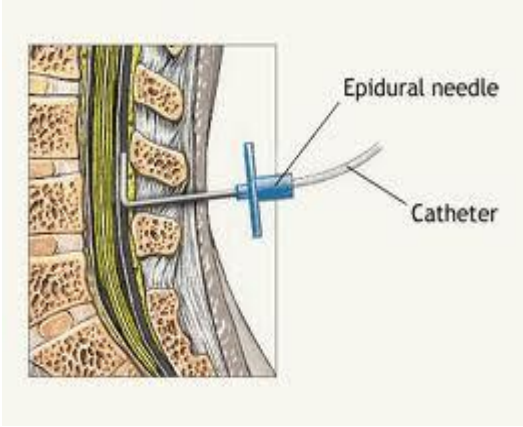
The spinal canal is formed by adjacent vertebral foramina. The canal provides support and protection to the spinal cord and its nerve roots. The spinal cord extends from the foramen magnum to the L1-2 vertebral level in adults, and L3 vertebral level in children before becoming the conus medullaris.

From the spinal cord extends a series of dorsal and ventral roots that converge to form mixed spinal nerves. The mixed nerves contain motor, sensory, and in

many cases, autonomic fibers. There are eight cervical, 12 thoracic, 5 lumbar, 5 sacral, and 1 coccygeal pairs of spinal nerves.

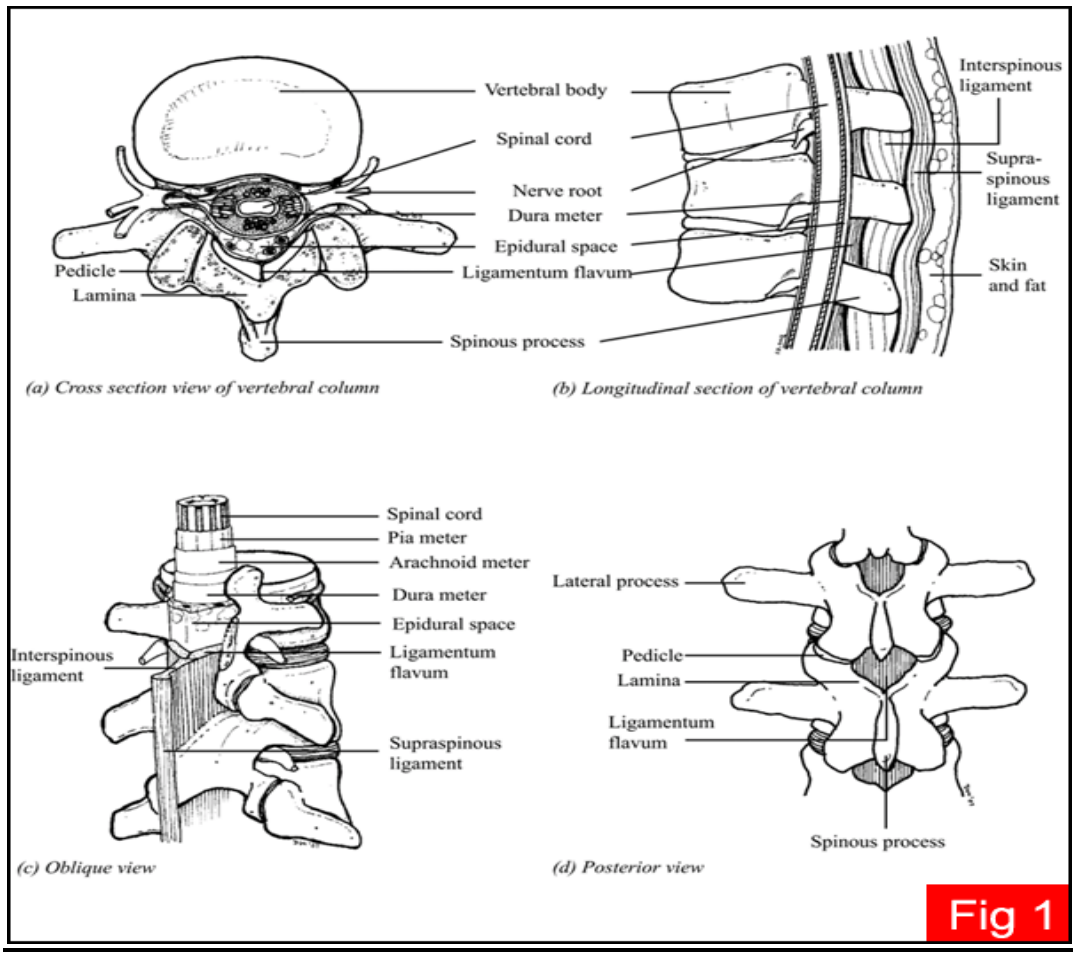
When performing an epidural, the needle passes through the following:

- Skin
- subcutaneous fat
- supraspinous ligament
- interspinous ligament
- ligamentum flavum



Surrounding the spinal cord and its roots are three layers of membranes. The innermost layer is called the pia mater, which attaches intimately to the surface of the spinal cord and roots of the spinal nerves. As the roots of the spinal nerves extend distally, the pia mater transforms into the second layer called the arachnoid. The arachnoid detaches from the roots and reflects back across the pia, enclosing the spinal cord within a cavity called the subarachnoid space. The space is filled with cerebrospinal fluid and transmits blood vessels to and from the spinal cord. Superficial to the arachnoid is the thick dura mater. The space between the arachnoid and dura is called the subdural space.

ANATOMY OF EPIDURAL SPACE:



The epidural space is smaller than the subarachnoid space, extends from the base of the skull to the sacral hiatus, and surrounds the dura mater anteriorly, laterally, and posteriorly. The epidural space is bound posteriorly by the ligamentum flavum and laterally by the pedicles and the intervertebral foramina. It is filled with the fat, areolar tissue, lymphatics, veins, and nerve roots that traverse it, but there is no free fluid.

The epidural space is rich in blood vessels, including Batson's venous plexus. Batson's plexus is continuous with the iliac vessels in the pelvis and the azygos system in the abdominal and thoracic body walls. Because this plexus has no valves, blood from any of the connected systems can flow into the epidural

vessels. This is especially important in obstetrics when compressed caval vessels can lead to engorgement of the epidural veins, increasing the risk of catheter entry into a vein. The engorgement is even greater at the intervertebral foramina where the vessels may bulge from the vertebral canal. Therefore, the incidence of penetrating a blood vessel with an "off-midline" needle insertion may be more likely.

The distance from the skin to epidural space is 4 to 5 cm in 80% of the population. It is shorter in lean individuals and deeper in obese individuals.

Characteristics of the Ligamentum Flavum at Different Vertebral Levels[1]

Site	Distance from Skin to Ligament (cm)	Thickness of Ligament (mm)
Cervical	—	1.5-3.0
Thoracic	—	3.0-5.0
Lumbar	3.0-8.0	5.0-6.0
Caudal	Variable	2.0-6.0

PHYSIOLOGICAL EFFECTS OF EPIDURAL BLOCKADE:

The primary site of action of local anesthetic solutions injected into the epidural space is the spinal nerve roots. The segmental nerve roots in the thoracic and lumbar regions are mixed nerves, containing somatic sensory, motor, and

autonomic nerve fibers. Sensory blockade interrupts the transmission of both somatic and visceral painful stimuli, whereas motor blockade provides muscle relaxation with a varying degree of sympathetic blockade.

- **CARDIOVASCULAR** - The effect of epidural anesthesia on the cardiovascular system depends on the level and the degree of sympathetic blockade. Vasomotor tone is maintained by sympathetic fibers from T5 to L1 that innervate vascular smooth muscle. Blockade of these fibers cause venodilation with venous pooling as well as arterial vasodilation with decreased systemic vascular resistance.

- **RESPIRATORY** - Epidural blockade to midthoracic levels have minimal effect on patients with adequate lung function. Lung volumes (tidal volume, vital capacity), resting minute ventilation, and dead space are basically unchanged even with a high thoracic epidural anesthesia. Even with abdominal or intercostal muscle paralysis by a high thoracic block, major alteration in pulmonary function is not seen.
- **GASTROINTESTINAL** - The gastrointestinal effects of epidural anesthesia are largely the result of blockage of the sympathetic splanchnic fibers from the T5 through L1 level. Unopposed vagal dominance leads to an increase in secretions; peristalsis; and a smaller, contracted gut.

- **RENAL -** Since renal blood flow is maintained through autoregulation, epidural anesthesia has very little effect on renal function. Urinary retention occurs until the regression of blockade.

- **NEUROENDOCRINE –** The stress hormones epinephrine, norepinephrine , vasopressin etc., released during surgical stimulus are reduced.

PHARMACOLOGY OF THE LOCAL ANESTHETIC ACTION:

Local anesthetic binds to sodium channels, primarily in the inactivated state, preventing further channel activation. Sodium ion movement into the cell is prevented, effectively blocking the development of the action potential. The resulting resting membrane potential is unaffected by further nerve stimulation, referred to as **membrane stabilization** of local anesthetics.

Within the dorsal horn, local anesthetics can block both sodium and potassium ion channels in the dorsal horn neurons, inhibiting the generation and propagation of pain signals (nociceptive electrical activity). Motor blockade occurs from a similar action on the ventral horn neurons. Blockade of calcium ion channels in the spinal cord leads to resistance of electrical stimulation from nociceptive afferent nerves, creating an intense analgesic action seen in centrally administered local anesthetics.

A variety of other classes of drugs have been studied more recently to try to improve the quality of neuraxial blockade, in the epidural space. In addition to a variety of opioids (eg, fentanyl,sufentanil), alpha-adrenergic agonists, cholinesterase inhibitors, semisynthetic opioid agonist–antagonists, ketamine, and midazolam have been studied with varied results.

Volume is the key factor in determining the height of block.. A larger volume will block a greater number of segments. A generally accepted guideline for dosing an epidural blockade in adults is 1–2 mL per segment to be blocked. This guideline should be adjusted for both short and tall patients.

Time to repeat a dose of local anesthetics depends on the duration of action of the drug. Doses should be administered before the block regresses to the point where the patient experiences pain, commonly referred[2] to as **"time to two-segment regression."** This is defined as the time it takes for the sensory block to regress by two dermatome levels. When two-segment regression has occurred, one-third to one-half of the initial loading dose can safely be administered to maintain the block.

TECHNIQUE:

Equipments required: 18 G or 16G , 9 cm Tuohy needle ,with a 15-20 degrees angulation at the tip (Hueber' s tip), 18 G epidural catheter, 5 ml syringe (for LOR), 2 ml syringe, local anesthetic preparation of 1.5 % lignocaine, filter.

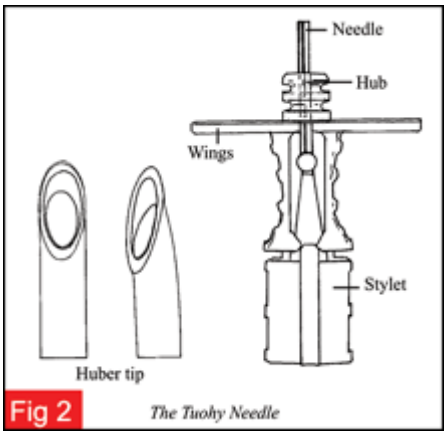


Fig 2 *The Tuohy Needle*

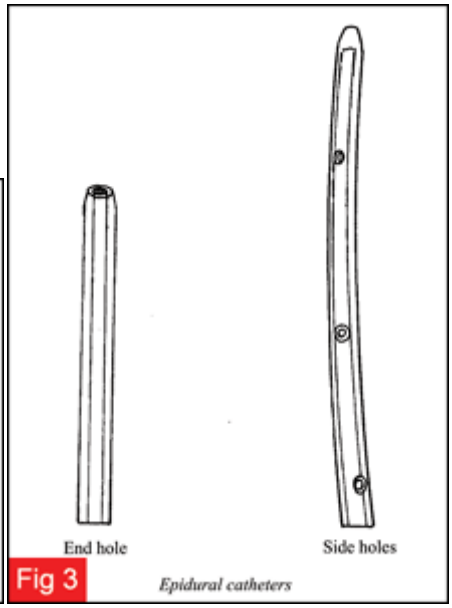


Fig 3 *Epidural catheters*

Position: sitting / lateral decubitus position.

Approach: Midline, Paramedian.

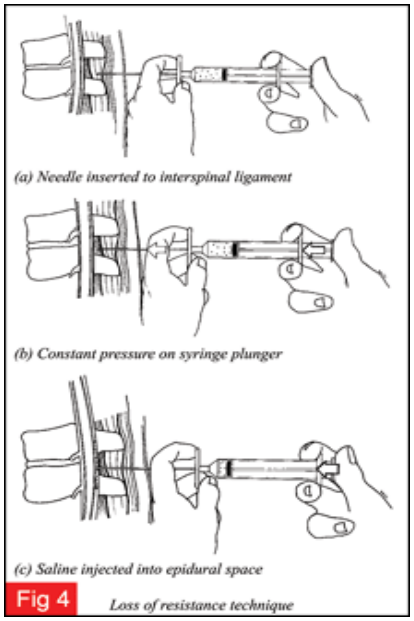


Fig 4 *Loss of resistance technique*

Procedure: 1. Confirm the regions of desired blockade. 2. Local anesthetic infiltration of the skin should be administered judiciously. 3. The epidural needle is inserted into the interspinous space. 4. Epidural space is located using the Loss of resistance technique or the Hanging drop sign. 5. The catheter is then threaded and placed 4 to 5 cm in the epidural space. 6. 3 ml of 1.5 % lignocaine with 1 in 2,00,000 adrenaline is given through the catheter and

misplacement into the subarachnoid, intravascular and subdural space ruled out. 7. The catheter is then secured.

FACTORS AFFECTING THE LOCAL ANESTHETIC ACTION:

1. *Site of injection* – after lumbar injection there is more cranial spread of the local anesthetic. In thoracic blockade there is equal spread.
2. *Volume* – lumbar segments require 1.5 to 2 ml per segment .Thoracic segments require 1 to 1.5 ml per segment.
3. *Age* – in old age there is narrowing of the interspinous process, due to calcification of the ligaments.
4. *Height* – shorter individuals require less volume of anesthetic.
5. *Weight* – obese individual require less volume due to narrowing of the interspinous spaces and engorgement of the epidural venous plexus.
6. *Posture* – In epidural anesthesia posture has no significant change.
7. *Alkalinisation of local anesthetics* – increasing the pH of the local anesthetic potentiates the onset of action.
8. *Adjuvants* – Addition of other adjuvants like epinephrine , opioids etc., potentiates the action and improves the quality of blockade.

INDICATIONS:

Epidural anesthesia/analgesia is administered in the following

1. Abdominal surgeries.
2. Lower limb surgeries
3. Obstetric & Gynaecological surgeries.
4. Urological surgeries
5. Orthopaedic surgeries
6. Vascular surgeries
7. Thoracic surgeries
8. Along with general anesthesia for post-op analgesia
9. Labor analgesia
10. Management of chronic pain

CONTRAINDICATIONS:

The following are the contraindications for epidural blockade

Absolute	**Relative**
Patient refusal	Coagulopathy
Increased ICP	Spine deformity
Localised infection	Un co-operative patient
Hypovolemia	Neurological disorders

SIDE EFFECTS:

Following are the side effects of epidural blockade

1. Hypotension
2. Inadvertent high blockade
3. Post dural puncture headache
4. Local anesthetic toxicity
5. Inadvertent high spinal
6. Hematoma
7. Infection- Epidural abscess, Meningitis
8. Allergy to local anesthetics
9. Anterior spinal artery syndrome
10. Arachnoiditis and Transverse myelitis.

FAILURE OF EPIDURAL ANESTHESIA :

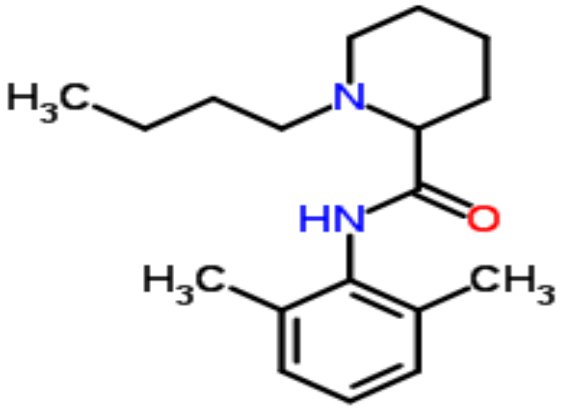
Entry into the epidural space is purely tactile, and the end point of entry is subject to misinterpretation. There are false losses of resistance, and quite often the only proof that the needle was correctly positioned is that the resulting block is effective.

The introduction of a catheter into the epidural space introduces an additional number of reasons for the failure of epidural anesthesia. The inability to pass a

catheter into the epidural space frequently indicates that the needle is not in the epidural space. Catheters may become occluded with blood, or the catheter may kink, take a unilateral course, break, or become knotted, all of which can contribute to the failure of epidural anesthesia.

An important distinction that should be made during epidural catheter threading is that of complete failure versus a partial blockade/failure. Epidural local anesthetic dosing for anesthesia may approach the maximum safe limit, preventing significant further administration of local anesthetic. Thus, a failed epidural may prompt the clinician to pursue an alternative course of anesthesia.

PHARMACOLOGY OF BUPIVACAINE



Bupivacaine[6] is an amide group of pipecoloxylidide local anesthetic. Bupivacaine is formed by addition of a butyl group to the piperidine nitrogen of Mepivacaine making it 35 times more potent. Local anesthetics prevent transmission of nerve impulses (conduction blockade) by inhibiting the passage of sodium ions through selective sodium channels in nerve membranes. However, they do not alter the resting membrane potential or threshold potential.

Bupivacaine binds to alpha subunit of the sodium channel

⇩

Na^+ channels exist in activated-open, inactivated-closed and resting-closed states

⇩

Bupivacaine selectively binds to sodium channels in inactivated-closed state

⇩

Prevent their change to rested- closed, activated-open states.

⇩

Sodium channels are not permeable in inactivated-closed state

⇩

NO conduction of impulses and **NO** action potential occurs

Frequency dependent blockade: Sodium ion channels tend to recover from local anesthetics induced conduction blockade between action potentials and to develop additional conductional blockade. Local anesthetics gain access to receptors only when sodium channels are in activated-open states. So, a resting nerve is less sensitive to conduction blockade than a repetitively stimulated nerve.

Other site of Action Targets: In addition to sodium channels bupivacaine blocks voltage dependent potassium ion channels. This explains the reason for broadening of action potential. Bupivacaine also blocks the calcium ion channels (L-type).

Bupivacaine blocks both types of pain fibres, myelinated A-delta and unmyelinated C-fibres. Preganglionic-B fibres are readily blocked by local anesthetics than the other two nerve fibres.

PHARMACOKINETICS:

Bupivacaine is a weak base that has a pKa value above the physiological pH. Hence only less amount of the drug is in non-ionised form. Acidosis increases

the pH of the medium causing more ionised fraction of drug resulting in poor quality of anesthesia.

Absorption of the drug depends on site of injection, its dosage, adjuvants such as epinephrine,opioids ,and the pharmacological characteristics of the drug. The plasma concentration is determined by the rate of tissue distribution and rate of clearance.

The lungs are capable of extraction of bupivacaine from the systemic circulation and its first pass pulmonary extraction is dose dependent.

Bupivacaine binds to the plasma protein alpha-1 acid glycoprotein. It undergoes aromatic hydroxylation, N-dealkylation, amide hydrolysis and conjugation.

Onset	Slow
Duration of action	240-480 mins
pKa	8.1
Protein binding	>97%
Potency	4
Toxic plasma concentration	>3µg/ml
Lipid solubility	28
Volume of distribution	73 litres
Clearance	0.47 litres/min
Elimination half time	210 mins

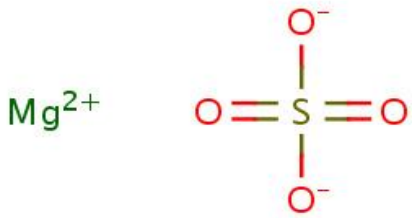
USES:

Regional Anesthesia – (i) local infiltration (ii) peripheral nerve block (iii) Epidural anesthesia (iv) Spinal anesthesia (v) Topical anesthesia

SIDE EFFECTS:

1. Allergic reactions
2. Neurotoxicity – tinnitus, vertigo , muscle twitches , slurred speech and seizures.
3. Cardiotoxicity – precipitous hypotension, cardiac dysrhythmias and atrioventricular blocks.
4. Hepatotoxicity

PHARMACOLOGY OF MAGNESIUM SULPHATE [15]



Magnesium is the fourth most common cation in the body and the second most common intracellular cation after potassium. Magnesium plays a fundamental role as a cofactor in many enzymatic reactions involving energy metabolism and nucleic acid synthesis. it is also involved in several processes including: hormone receptor binding ;gating of calcium channels; transmembrane ion flux; muscle contraction; neuronal activity; control of vasomotor tone; cardiac excitability and neurotransmitter release.

Magnesium is distributed principally in bone (53%), intracellular compartments of muscle (27%) and soft tissues (19%). Serum magnesium comprises only 0.3% of total body magnesium stores. It is present in 3 forms

1. Ionised (62%)
2. Protein bound(33%),mainly albumin
3. Bound to citrate and phosphate (5%)

Magnesium is absorbed in the ileum and colon. Its absorption is inversely proportional to intake. Excretion occurs via the kidney .along with the other

cations magnesium is filtered at the glomerulus, but reabsorption occurs in the ascending loop of henle and not proximal convoluted tubule.

Magnesium in its many of its properties mimics a **physiological calcium antagonist.** A common pathway for the release of hormones, growth factors, and neurotransmitters is phospholipase C activation and hydrolysis to inositol 4, 5 triphosphate (IP_3). This (IP_3) binds to the calcium channels and releases calcium. Magnesium is a non-competitive inhibitor of the (IP_3) gated calcium channel. It may also inhibit the ryanodine receptors to release calcium ions in the sarcoplasmic reticulum.

Only 0.3% of the total body magnesium is available in serum for estimation. Henceforth estimation of serum levels does not reflect the total body magnesium stores. Normal serum magnesium levels are 1.5 – 2.5 mEq/L. When the levels are below 1.5mEq/L it is called as **HYPOMAGNESEMIA**. When the levels are greater than 2.5mEq/L it is termed as **HYPERMAGNESEMIA**. Another parameter for estimation is 24hr urinary magnesium concentration which is 5-15 mEq/24hr.

MAGNESIUM DEFICIENCY:

Magnesium deficiency is often multifactorial and is usually found to coexist along with other electrolyte abnormalities, particularly hypokalemia or hypophoshatemia. Following are the causes for magnesium deficiency (i) reduced intake (ii) poor G.I. absorption (iii) increased losses through diarrhoea,

vomiting (iv) increased renal losses (v) diabetes mellitus (vi) alcoholism (vii) drug induced – diuretics, aminoglycosides etc,

Clinical features: (i) usually assosciated with hypocalcemia and hypokalemia (ii) arrhythmia- Torsades de pointes, a polymorphic ventricular tachycardia (iii) neurologic manifestations include altered mentation, seizures, tremors and hyperreflexia.

A serum concentration of less than 1 mEq/L is treated with 6 g magnesium sulphate in 250 ml isotonic saline and infused over 3 hours followed by 5 g magnesium sulphate over next hours. Continue with 5 g magnesium sulphate every 12 hours for next 5 days.

MAGNESIUM TOXICITY:

Serum magnesium levels more than 2.5 mEq/L is termed as hypermagnesemia. Following are the causes: (i) hemolysis from haemolytic anemia or trauma (ii) renal insufficiency (iii) diabetic ketoacidosis (iv) adrenal insufficiency (v) hyperparathyroidism (vi) lithium intoxication.

Following are the clinical features.

Manifestation	**Serum magnesium (mEq/L)**
Hyporeflexia	>4
1 st degree AV block	>5
Complete heart block	>10
Cardiac arrest	>13

Management is by (i) hemodialysis is the treatment of choice for severe hypermagnesemia (ii) intravenous calcium gluconate 1 g over 2-3 mins is used to antagonise the cardiovascular effects (iii) aggressive volume infusion with furosemide.

MAGNESIUM SULPHATE IN OBSTETRICS:

Magnesium sulphate remains the drug of choice in the treatment eclampsia. 4 to 6 gm i.v. magnesium sulphate is diluted in 100 ml of normal saline given over 15 mins. This is followed by infusion of 2 gm/hr i.v. in 100 ml normal saline. Target serum magnesium levels are 4 to 7 mEq/L.

Another alternative regimen is Pritchard's regimen: 4gm magnesium sulphate given slow i.v. followed by 10 gm, of which 5 g is given in each buttocks as deep i.m.injection. Use of magnesium sulphate in cases of pre-eclampsia is yet to be proven.

Magnesium sulphate is known to have tocolytic effect. An i.v.bolus of 2-4 g over 24 hrs followed by 1-2 g/hr i.v.infusion and is regulated based on uterine responses. Tocolysis is known to be effective with a target serum level of 8 mEq/L.

Obervational studies have proven the decrease in incidence of cerebral palsy in low birth infants in mothers treated with magnesium sulphate.

MAGNESIUM SULPHATE IN CARDIOLOGY:

It acts on calcium channels in the myocardial muscle and also acts indirectly on the cardiac muscle by inhibiting the calcium uptake on the Troponin C of the myocytes and thereby influencing myocardial contractility. Its vasodilatory action is due to its activation of cyclic AMP. This causes reduction in systolic blood pressure. Pulmonary vascular resistance is unaltered. Coronary vascular resistance is reduced and causes vasodilation.

Uses:

1. In acute Myocardial infarction – 2 gm Magnesium sulphate intravenously over 5 to 15 mins followed by 18 gm over 24 hours.
2. In the treatment of arrhythmias-(i) Torsades de pointes intravenously 25 to 50 mg/kg, can be given upto 2 gm.(ii) in atrial or ventricular arrhythmias along with hypokalemia.
3. Hypomagnesemia is common after CABG, henceforth its use in postoperative period prevents arrhythmias.

MAGNESIUM IN NEUROMUSCULAR BLOCK:

Magnesium ions have an inhibitory effect on postjunctional potentials and decrease in muscle fibre membrane excitability. It also has a preponderant action on presynaptic potentials by competitively blocking the entry of calcium

ions. Presynaptic inhibition in release of acetylcholine decreases the effect on postsynaptic receptors which in turn increases the threshold of axonal excitation, thereby potentiating the neuromuscular blockade action.

MAGNESIUM IN CENTRAL NERVOUS SYSTEM:

Magnesium sulphate has been found to possess NMDA receptor antagonistic property thereby inhibits induction and central sensitisation after nociceptive stimuli.

In many studies magnesium is found to possess the analgesic property when administered by intravenous, intrathecal and epidural routes. Magnesium when administered intravenously dosage varies from 30mg to 50 mg per kg body weight. In the neuraxial blockade a dosage of 50 mg has been found to have desired analgesia. Therefore this explains its use in intraoperative and postoperative analgesia.

Nephritic Seizures: In children with nephritic seizures, the 50% concentration should be diluted to a 20% solution for i.m. injection. The dose for children is

20 to 40 mg (0.1 to 0.2 mL of a 20% solution)/kg of body weight, administered i.m. as needed, to control seizures.

Magnesium as already explained possesses anti-epileptic property in Eclampsia, although its effect on other types of seizures is yet to be proved.

MAGNESIUM IN RESPIRATORY SYSTEM:

It has bronchodilatory action due to the inhibition of smooth muscle contraction, histamine release from the mast cells and acetylcholine release from the cholinergic nerve endings. This explains its use in bronchial asthma.

MAGNESIUM DECREASES CATECHOLAMINE RELEASE:

Magnesium is known to have marked anti adrenergic effect, which is mediated by calcium antagonism. This anti-adrenergic property along with vasodilatory and anti-arrhythmic effect makes its use beneficiary in Pheochromocytoma.

This property facilitates its use for nullifying the stress response for tracheal intubation. To reduce the stress response during intubation, magnesium sulphate is used in the dosage of 30-50mg/kg intravenously.

PREPARATIONS AVAILABLE:

Magnesium sulphate- 10%, 12.5%, 50%, 4%, 8%.

When administered intravenously the onset of action is immediate and duration of action is 30 min. On administration by intramuscular route the

onset of action takes 1hr and duration of action is 3-4 hrs. For IV use concentration of 20% or less should be used. Rate of injection should be 1.5ml/hr

Storage: 15-30degree centigrade

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DRUG INTERACTIONS:

- Central nervous system depressants: When barbiturates, opiates, general anaesthetics, or other CNS depressants are administered concomitantly with magnesium sulphate, dosage of these agents must be carefully adjusted because of the additive central depressant effects.

- Neuromuscular blocking agents: Excessive neuromuscular blockade has occurred in patients receiving parenteral magnesium sulphate and a neuromuscular blocking agent; these drugs should be administered concomitantly only with caution.

- Cardiac glycosides: Magnesium salts should be administered with extreme caution in digitalized patients, because serious changes in cardiac conduction, which can result in heart block may occur if administration of calcium is required to treat magnesium toxicity.

ADVERSE REACTIONS:

The adverse effects of parenterally administered magnesium usually are the result of magnesium intoxication. These include flushing, sweating, hypotension, depressed reflexes, flaccid paralysis, hypothermia, circulatory collapse, cardiac and CNS depression proceeding to respiratory paralysis.

Hypocalcemia with signs of tetany secondary to magnesium sulphate therapy for eclampsia, has been reported.

REVIEW OF LITERATURE

1)Tanmoy et al[8], had done a study on evaluation of the effect of adding magnesium sulphate or clondine in the epidural route along with bupivacaine in patients coming for lower abdominal and lower limb surgeries. Study groups were divided into Group B which received 1 ml magnesium sulphate (50 mg) + 19 ml 0.5% bupivacaine, Group C which received 1 ml clonidine (150 mcg) +19 ml 0.5%bupivacaine and control Group A which received same volume of normal saline along with 19 ml 0.5% bupivacaine.

The time taken for onset of sensory blockade at T6 level was least in Group B (11.80 ± 3.21 minutes) highest in control Group A (18.73 ± 2.79 minutes) and in Group C was 16.93 ± 3.43 minutes. The difference was statistically significant ($p<0.05$). The early onset of action in the magnesium group was explained by the property of NMDA receptor antagonism which has prevented central sensitisation to peripheral nociceptive stimulation.

The time for first epidural top up in Group B was 161.67 ± 30.10 minutes, Group C 180.33 ± 29.97 minutes and in Group A 150.67 ± 35.80 minutes. The time for two segment regression in Group B 130.33 ± 39.34 minutes ,Group C 145.33 ± 27.74 minutes and in control Group A 123.0 ± 28.08 minutes. The duration of action was longer in the Clonidine group.

The incidence of shivering was 13.3% in control group, 33.3% in clonidine group and no cases reported in magnesium group.

They study concluded that co-administration of epidural magnesium sulphate with bupivacaine produces predictable rapid onset of surgical anesthesia without any side effects and addition of clonidine to epidural bupivacaine produces prolonged analgesia with sedation.

2) A.Bilir [9] et al , had conducted a study on the effect of adding epidural magnesium sulphate for post-operative analgesia in patients undergoing hip surgery. After the surgery patients were made to receive patient controlled epidural analgesia (PCEA). Patients received 25 mcg fentanyl with a lock out interval of 20 min and 4 hr limit of 150 mcg fentanyl. Patients were ascertained into two groups, Group FM received 50 mg magnesium sulphate bolus followed by continuous infusion of 100 mg magnesium sulphate for 24 hr period and the other Group F received similar volume of normal saline.

The cumulative fentanyl consumption in 24 hr period was 437 mcg in Group F, while in Group FM it was 328 mcg which was statistically significant ($p< 0.05$). There was no significant side effect in both groups. The study concluded that coadministration of magnesium for post-operative epidural analgesia reduces fentanyl consumption with no side effects.

3) S.Farouk [10], had conducted a study to evaluate preventive and preemptive analgesic efficacy of adding magnesium sulphate to a multimodal regimen of patient controlled analgesia (PCEA) in patients undergoing abdominal hysterectomy.

Three groups were randomly categorised. In the pre-magnesium group 50 mg magnesium sulphate was given before induction followed by 10 mg/hr until the end of surgery. In the post magnesium group 50 mg magnesium sulphate was given after the surgery with no infusions and the control group received equal volume of saline throughout the course. Surgery was proceeded under general anesthesia. Patients in the magnesium groups received PCEA with fentanyl 1 µg/ ml, bupivacaine 0.08%, and magnesium 1 µg/ml after operation. Patients in the control group received PCEA with fentanyl 1 µg/ml and bupivacaine 0.08%.

There was significant lower pain scores in the pre-magnesium group ($p < 0.05$) and the opioid dose consumed in the post-magnesium group was less than in the control group ($p < 0.05$). There were no significant side effects in all the groups. The study was concluded that continuous epidural magnesium started before anesthesia provided preventive, preemptive analgesia and an analgesic sparing effect that improved the postoperative analgesia without any side effects.

4) Yousef[11] et al, had conducted a study to evaluate the effect of adding magnesium sulphate to epidural bupivacaine and fentanyl in elective caesarean section using combined epidural and spinal anesthesia.

All patients received 2 mL intrathecal 0.5% hyperbaric bupivacaine, 10 mL epidural 0.25% plain bupivacaine with fentanyl 100 µg, and were randomly allocated in to two groups to receive either 10 mL of epidural 0.9% sodium chloride or 10 mL epidural 5% magnesium sulphate.

It was found that women who received epidural magnesium had a greater muscle relaxation ($p<0.05$). APGAR scores were > 7. Women who received magnesium showed less shivering and later onset of post operative pain ($P<0.05$).

The addition of magnesium to epidural bupivacaine and fentanyl in women undergoing elective caesarean section with combined spinal-epidural anaesthesia improved intraoperative conditions and the quality of postoperative analgesia.

5) Aricioni[17] et al, had conducted a, double-blind, placebo-controlled trial, with 120 consecutive patients undergoing orthopedic surgery during spinal anesthesia (levobupivacaine and sufentanil). Patients were randomly assigned to receive intrathecal $MgSO_4$ (94.5 mg, 6.3%), epidural $MgSO_4$ (2%, 100 mg/h), intrathecal and epidural $MgSO_4$ combined or spinal anesthesia alone (controls). Post-operative morphine consumption was assessed in all groups by patient-controlled analgesia (PCA)

Morphine consumption at 36 h after surgery was 38% lower in patients receiving spinal anesthesia plus epidural $MgSO_4$. 49% lower in those receiving spinal anesthesia plus intrathecal $MgSO_4$ and 69% lower in the intrathecal-epidural combined group relative to control patients receiving spinal anesthesia alone.

6) H.Birbicer[13] et al, had conducted a study of adding magnesium sulphate in caudal epidural in children coming for penoscrotal and lower abdominal surgeries. Two groups were randomly ascertained. The study group received magnesium sulphate 50 mg while the control group received equal volume saline,along with 0.25 % ropivacaine after the induction of general anesthesia.

The postoperative analgesic consumption did not show statistical significance ($p>0.05$) and the analgesic requirements were equal in both the groups.

7) Jong Wha Lee[15] et al , conducted a study to evaluate the analgesic effect of magnesium sulphate administered intrathecally. Two groups were made in random. The study group received 50 mg magnesium sulphate with 10 mg tetracaine while the control group received equal volume saline along with 10 mg tetracaine. Postoperative rescue analgesic contained 0.2% ropivacaine in the Magnesium group and 0.2% ropivacaine plus morphine in the control group via epidural catheter.

The VRS score at 120 minutes after the IT injection were lower in group M than in group C ($p < 0.05$). There were no differences in the VRS scores and the use of supplemental analgesics at the postoperative period. The incidence of PONV, pruritus and urinary retention was significantly lower in group M than in group C at 12 and 36 hours after surgery.

8)M.Ozalevli [12] et al, had conducted a study on the effect of adding magnesium sulphate to bupivacaine-fentanyl spinal anesthesia. The study group received 50

mg magnesium sulphate along with fentanyl while the control group received bupivacaine with fentanyl and same volume of 0.9 % preservative free normal saline.

The mean duration of analgesia was longer in the magnesium group ($p < 0.001$). The study concluded that addition of magnesium sulphate prolongs spinal opioid analgesia.

9) Asokkumar Buvenendran[14] et al, had conducted a study on adding magnesium sulphate along with fentanyl in combined spinal – epidural labor analgesia. The study group received 25 mcg fentanyl and 50 mg magnesium sulphate while the control group received fentanyl 25 mcg and normal saline.

The median duration of analgesia in the magnesium group was 75 minutes while in the saline group it was 60 mins. In conclusion it was demonstrated that addition of magnesium sulphate prolongs the opioid analgesia.

10)Khalili [37] et al , had conducted a study on the effect of adding magnesium sulphate as an adjunct to bupivacaine for spinal anesthesia in patients undergoing lower extremity surgeries. Two groups were randomnly selected,one group received 100 mg magnesium sulphate with 15 mg bupivacaine and the other group received 15 mg bupivacaine with normal saline (0.2 ml). The onset of sensory blockade was slower with magnesium $p=0.04$, but the duration of sensory blockade was longer $p=0.001$. In conclusion addition

of magnesium sulphate to spinal anesthesia prolonged the duration of sensory block and decreased postoperative analgesic requirement.

11) Martin R.Tramer [33] et al, had conducted a study on effect of administering magnesium sulphate intravenously in the perioperative period. The study group received 20%magnesium sulphate 15 ml intravenously before the surgery and 2.5ml/hr for the next 20 hours. The control group received similar volume of saline. Post operative morphine consumption using patient controlled analgesia was assessed for 48 hours.

During the first 48 hours morphine consumption was reduced in the magnesium group with a significant $p<0.03$, which was more pronounced at the 6 th hour ($p<0.004$). In the second and the third postoperative days there was less discomfort ($p<0.05$). The study concluded that perioperative administration of magnesium sulphate reduces postoperative analgesia requirement with no adverse effects.

12)Michael.F.James [18] et al, had conducted a study on the effect of 60 mg/kg intravenous magnesium sulphate pretreatment on cardiovascular responses and catecholamine release associated with tracheal intubation. The effects were measured in 15 study group patients and in 15 saline solution pre-treated controls. After intubation, heart rate was unchanged in the magnesium group at 107.3 ± 3.6 beats/minute but increased in the control group to 120.9 ± 4.6 beats/minute ($P<0.05$). Systolic blood pressure increased after intubation from

106.8 ± 3.1 to 121.0 ± 4.4 mm Hg in patients given magnesium and from 106.4 ± 3.12 to 145.1 ± 5.6 mm Hg in the control group (P<0.05). Norepinephrine levels increased from 297.3 ± 20.9 pg/ml to a peak of 532.5 ± 30.1 pg/ml 2 minutes after intubation in the magnesium group. In controls, norepinephrine levels increased from 273.3 ± 39.1 mg/ml to 944.6 ± 68.7 pg/ml (P<0.05 for differences between groups). Epinephrine levels were unchanged from baseline after magnesium but in controls increased from 113.9 ± 19.5 to 279.6 ± 92.3 pg/ml (P<0.05) . The study concluded that magnesium sulphate attenuates the catecholamine mediated responses after tracheal intubation.

13)Gozdemir [39] et al, had conducted a study to evaluate whether magnesium sulphate infusion during surgery reduces shivering during spinal anesthesia in patients coming for Transurethral resection of prostate(TURP) surgeries. Two groups were divided, both groups received 3 ml of bupivacaine intrathecally and one group received a bolus of 80 mg/kg over 30 min period followed by 2 g/hr infusion during the intraoperative period and the other group received equal amounts of normal saline. Shivering was significantly reduced in the magnesium group (p=0.001).

AIM OF THE STUDY

To evaluate the role of Magnesium sulphate as an adjuvant in accelerating the onset of action of injection Bupivacaine in epidural anesthesia in patients coming for lower abdominal surgeries.

MATERIALS AND METHODS

After approval of the study by our institutional ethics committee, the study was conducted in 50 ASA grade I or II patients undergoing elective lower abdominal surgeries under epidural anaesthesia.

The age, weight, and height, vital parameters like pulse rate, blood pressure, baseline investigations like hemoglobin, blood sugar, urea, creatinine, CXR and ECG were all checked. Thorough examination of all the systems and airway assessment was done.

INCLUSION CRITERIA:

- Patients between the age group 18 to 60 yrs
- Patients in ASA I and II physical status
- Patients with BMI < 30 kg/m^2
- Patients coming for elective surgeries
- Patients who have given valid informed consent

EXCLUSION CRITERIA:

- Patients with coagulation abnormality
- Patients with cardiac or renal failure
- Patients with mental illness
- Patients with neurological illness
- Patients with spinal deformities

- Patients with allergy to local anesthetics
- Patients coming for emergency surgeries
- Patients not fitting into inclusion criteria

The patients who fulfilled the above explained criteria were taken into the study after obtaining written informed consent from them.

MATERIALS USED:

- 18 G or 16 G, 9 cm Tuohy needle, with a 15-20 degrees angulation at the tip (Hueber's tip), filter.
- 18 G epidural catheter
- 5 ml syringe (for LOR)
- 2 ml syringe
- local anesthetic preparation of 1.5 % lignocaine with 1 in 2 lac adrenaline

Visual Analog Scale (VAS) was explained to the patients. The patients were shown a 10 cm long scale marked 0 – 10 on a blank paper and told that 0 represented "no pain" and 10 represented "worst possible pain". Rectus Abdominis Muscle score was also explained to the patients. A score of 60 % represented adequate blockade.

The patients were randomly allocated into two groups of 25 each by using closed envelop method.

GROUP A:

Patients received 14 ml of 0.5% Bupivacaine + 1ml of 0.9% Normal saline.

GROUP B:

Patients received 14 ml of 0.5%Bupivacaine +1ml of 50 mg Magnesium sulphate.

The total volume of the injected solution was 15 ml in both groups. In the operating room, appropriate equipment for airway management and emergency drugs were kept ready. Patients were shifted to the operating room. The horizontal position of the operating table was checked and the patients were positioned. Non-invasive blood pressure monitor, pulse oximeter and ECG leads were connected to the patient.

Preoperative baseline systolic and diastolic blood pressure, pulse rate, respiratory rate and oxygen saturation were recorded. Patients were cannulated with 18G intravenous cannula and preloaded with 1000 ml of crystalloid solution. The patients were placed in sitting position. The skin over the back was prepared with antiseptic solution and draped with sterile towel. T 9 – T 10 or the T 10 – T 11 interspace was chosen for performing the epidural blockade. After infiltrating the skin with local anesthetic, 18 G tuohy needle was inserted. The epidural space was identified by loss of resistance technique using the LOR syringe. Catheter was threaded cephalad and was placed at a length of 4 to 5 cm in the epidural space. A test dose of 3 ml of 1.5% lignocaine with adrenaline

(1:2, 00,000) was given through the epidural catheter. After ruling out intrathecal, intravascular, subdural placement and ensuring the catheter being

placed in the epidural space the catheter was fixed in situ. The test drug was given and following parameters were monitored.

ONSET OF SENSORY BLOCK:

The onset of sensory block was defined as the time between the injection of anaesthetic solution and the absence of pain at the T6 dermatome. Sensory block was assessed by loss of sensation to pinprick by VAS scoring using 22G sterile needle bilaterally along the midclavicular line. Sensory blockade was checked every 5 mins until T6 dermatome was blocked and also the peak sensory blockade level was noted. The duration of sensory block was defined as the time for regression of two segments from the maximum block height and was evaluated by pin prick. Sensory blockade was checked every 15 mins till two segment regression level reached.

VAS SCORE:

0 – DOES NOT HURT

2 – HURTS JUST A LITTLE BIT

4 – HURTS A LITTLE MORE

6 – HURTS EVEN MORE

8 – HURTS A LOT

10 – HURTS AS MUCH AS U CAN IMAGINE

Time to achieve Score of 0 at T6 was taken as the time for onset of sensory blockade.

MOTOR BLOCK:

Motor block was assessed using two scores. The scoring system used was RAM (Rectus Abdominis Muscle). This test is employed for assessing the motor blockade levels above T12. The other test is the BROMAGE scoring system for assessing the motor blockade below L 1.

TIME TO REACH MOTOR BLOCK:

BROMAGE - 0 – no motor block

BROMAGE - 1 – inability to raise extended legs

BROMAGE - 2 – inability to flex knees

BROMAGE - 3 – inability to flex ankle joint.

RAM TEST [5]:

100% – able to rise from supine to sitting with hands behind head

80% – sit only with arms extended

60% – can lift only head and scapula

40% - can lift shoulders only off bed

20% - an increase in abdominal muscle tone can be felt during effort, no other response.

A RAM score of 40% to 60% was considered adequate to proceed with the surgery. Time taken for obtaining 60 % was taken as the duration of onset for motor blockade.

The surgery was commenced after obtaining the sensory blockade of level T6 and motor blockade of 60%.

VITAL SIGNS:

After performing the blockade, the systolic blood pressure, diastolic blood pressure, heart rate, SpO_2, respiratory rate were recorded once in every 5 mins till the level of two segment regression was reached and monitoring was continued throughout the procedure. Patients were shifted to post anesthetic care unit and the vital signs were monitored every 15 mins for the first 2 hours and then half hourly for 2 hours and every hour for the next 3 hours. Patients were then shifted to Post-operative ward after obtaining a bromage score of 0.

SIDE EFFECTS:

Hypotension was defined as fall in systolic blood pressure to more than 30 % its baseline value. It was managed with i.v.fluids and with incremental doses of Inj.Ephedrine 6 mg i.v.

Bradycardia was defined as fall in heart rate < 60 /min and was managed with Inj.Atropine 0.6 mg i.v. Tachycardia was defined as HR > 100/ min and was planned to manage the cause.

Respiratory depression was defined as respiratory rate < 8/min or SpO_2 < 85% and was planned to manage with mask ventilation,intubation and IPPV as per the requirement.

Vomiting was managed with Inj.Ondansetron 8 mg intravenously.

After the wearing of analgesic effect of the initial dose, 7 to 10 ml of 2% Lignocaine was supplemented in the epidural route for the continuation of the surgery.

Shivering was managed with administrations of warm i.v.fluids and covering the patient with warm towels.

TIME FOR TWO SEGMENT REGRESSION:

The duration of two segment regression was defined as the time taken for the sensory block to regress from the maximum level of blockade to two segments down. This time was taken as time for the first epidural top up and was supplemented with local anesthetics of half or one third of the initial dose with **NO** supplemental doses of magnesium sulphate.

PROBLEMS IN EPIDURAL BLOCKADE[5]:

Problem in epidural blockade was defined as inability to obtain adequate sensory blockade and motor blockade within the segmental area within 30

minutes of giving the **TEST drug** in the epidural route. **No** supplemental doses were given. These patients were converted to general anesthesia with tracheal intubation and IPPV.

All recorded datas were analysed with SPSS software for Windows Version 15.0. The quantitative datas were analysed by students t-test and the qualitative data by chi-squared test. Power analysis was calculated using Minitab for windows and the power was well above the accepted level of 80%.

OBSERVATION & ANALYSIS

This prospective randomised, comparative, double blinded case control study evaluates the effect of Magnesium sulphate in accelerating the onset of action of bupivacaine in epidural anesthesia in 50 patients coming for lower abdominal surgeries.

Results were expressed as mean and standard deviation. All statistical analysis were carried out using SPSS for windows version 15.0. The t-test was used for comparison of quantitative variants. A p value of less than 0.05 was considered statistically significant.

TABLE 1: Demographic Profile-AGE

GROUP	No.	Mean	SD	P VALUE
A	25	39.08	12.622	0.738 ***Not significant***
B	25	40.20	10.813	

The age distribution in group B was from 22 to 58 yrs and in group A was 21 to 59 yrs. The mean age and age distribution in both groups were similar and comparable.

TABLE 2: Demographic Profile-SEX

GROUP	MALE		FEMALE		P value
	NO	%	NO	%	1.000
A	20	80.0	5	20.0	***Not***
B	20	80.0	5	20.0	***significant***

Of the 50 patients, 40 were males and 10 were females. The distribution was similar and comparable in both groups of patients.

TABLE 3: Demographic Profile-BMI

Group	NO	Mean	SD	P value
A	25	23.19	1.678	0.375
B	25	22.63	2.968	***Not significant***

The mean BMI of group A is 23.19 and group B is 22.63.

The data is statistically not significant ($p>0.05$) and this both groups are comparable in terms of BMI.

TABLE 4: Demographic Profile-ASA PS Status

GROUP	ASA I		ASA II		P value
	NO	%	NO	%	0.082
A	20	80.0	5	20.0	***Not***
B	24	96.0	1	4.0	***significant***

In group A 20 patients were ASA I and 5 were ASA II patients. In group B 24 patients were in ASA I and 1 was ASA II patient.

The data is statistically not significant (p>0.05) and this both groups are comparable in terms of ASA PS Status.

TABLE 5: ONSET OF SENSORY & MOTOR BLOCKADE:

	GROUP	NO	MEAN	SD	P value
Onset of Sensory Block	A	25	17.80	2.533	<0.001 ***significant***
	B	25	11.20	2.179	
Onset of Motor Block	A	25	23.60	3.391	<0.001 ***significant***
	B	25	13.80	2.986	

In group B the mean time for onset of action of sensory block is 11.20 minutes compared to 17.80 minutes in group A. This data is statistically significant by Students *t*-test.

In group B the mean time for onset of action of motor blockade is 13.80 minutes against 23.60 minutes in group A. This data is statistically significant by Students *t*-test.

TABLE 6: TIME FOR TWO SEGMENT REGRESSION:

GROUP	NO	MEAN	SD	P value
A	25	51.00	7.500	<0.001 ***significant***
B	25	84.00	7.500	

The mean time for two segment regression in group B is 84.00 minutes against 51.00 minutes in group A.

Statistical analysis is done using Student *t*- test. It reveals a P value of <0.001 which is statistically significant.

TABLE 7: HEART RATE:

HR	GROUP	NO	Mean	SD	P value
Baseline	A	25	89.32	11.957	0.906 ***Not significant***
	B	25	89.72	11.936	
5 MINS	A	25	82.76	7.224	0.047 ***significant***
	B	25	77.84	9.647	
10 MINS	A	25	76.68	8.081	0.216 ***Not significant***
	B	25	73.84	7.941	
15 MINS	A	25	73.48	6.893	0.436 ***Not significant***
	B	25	71.76	8.521	
20 MINS	A	25	73.04	7.300	0.750 ***Not significant***
	B	25	72.36	7.675	
25 MINS	A	25	71.96	7.408	0.879 ***Not significant***
	B	25	71.64	7.348	
30 MINS	A	25	73.60	8.475	0.558 ***Not significant***
	B	25	72.20	8.292	
35 MINS	A	25	72.48	8.559	0.606 ***Not significant***
	B	25	71.12	9.926	
40 MINS	A	25	71.08	9.699	0.617 ***Not significant***
	B	25	72.40	8.836	
45 MINS	A	25	72.48	9.980	0.043 ***significant***
	B	25	78.24	9.641	
50 MINS	A	25	76.28	10.730	0.783 ***Not significant***
	B	25	75.36	12.639	
55 MINS	A	25	77.80	9.713	0.200 ***Not significant***
	B	25	74.28	9.454	
60 MINS	A	25	76.88	9.506	0.138 ***Not significant***
	B	25	72.96	8.876	
65 MINS	A	25	76.32	8.654	0.068 ***Not significant***
	B	25	71.28	10.338	
70 MINS	A	25	74.72	7.706	0.826 ***Not significant***
	B	25	74.12	11.189	
75 MINS	A	25	74.48	8.714	0.778 ***Not significant***
	B	25	75.20	9.201	
80 MINS	A	25	74.72	8.116	0.062 ***Not significant***
	B	25	70.52	7.394	
85 MINS	A	25	75.04	8.085	0.126 ***Not significant***
	B	25	70.84	10.796	
90 MINS	A	25	74.92	7.863	0.641 ***Not significant***
	B	25	73.80	8.958	

Though the data is statistically significant at 5 and 45 mins both groups are comparable in terms of heart rate with no specific clinical significance.

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TABLE 8: SYSTOLIC BLOOD PRESSURE:

	GROUP	N	Mean	SD	P value
SBP - Baseline	A	25	127.96	9.167	0.114 ***Not significant***
	B	25	124.04	8.008	
SBP - 5	A	25	113.36	8.261	0.001 ***significant***
	B	25	103.56	8.471	
SBP - 10	A	25	102.72	7.430	0.010 ***significant***
	B	25	97.56	6.028	
SBP - 15	A	25	99.84	6.524	0.471 ***Not significant***
	B	25	101.36	8.169	
SBP - 20	A	25	102.12	8.536	0.986 ***Not significant***
	B	25	102.16	8.019	
SBP - 25	A	25	104.12	8.288	0.701 ***Not significant***
	B	25	103.16	9.241	
SBP - 30	A	25	103.80	9.260	0.390 ***Not significant***
	B	25	106.04	8.988	
SBP - 35	A	25	107.92	9.522	0.746 ***Not significant***
	B	25	107.16	6.737	
SBP - 40	A	25	109.64	9.634	0.692 ***Not significant***
	B	25	108.60	8.827	
SBP - 45	A	25	115.48	12.910	0.023 ***significant***
	B	25	108.36	7.926	
SBP - 50	A	25	114.56	13.690	0.139 ***Not significant***
	B	25	109.76	8.202	
SBP - 55	A	25	111.32	10.439	0.843 ***Not significant***
	B	25	111.88	9.391	
SBP - 60	A	25	111.64	7.931	0.319 ***Not significant***
	B	25	114.24	10.183	
SBP - 65	A	25	113.68	8.260	0.780 ***Not significant***
	B	25	114.32	7.841	
SBP - 70	A	25	114.68	9.406	0.758 ***Not significant***
	B	25	113.92	7.884	
SBP - 75	A	25	115.44	8.267	0.974 ***Not significant***
	B	25	115.52	9.038	
SBP - 80	A	25	116.44	8.347	0.636 ***Not significant***
	B	25	117.60	8.865	
SBP - 85	A	25	117.32	8.355	0.171 ***Not significant***
	B	25	120.32	6.848	
SBP - 90	A	25	118.60	7.427	0.015 ***significant***
	B	25	124.00	7.719	

Though the data is statistically significant at 5, 10, 45 and 90 mins both groups are comparable in terms of Systolic Blood Pressure with no specific clinical significance.

TABLE 9: DIASTOLIC BLOOD PRESSURE:

	GROUP	N	Mean	SD	P value
DBP - Baseline	A	25	78.84	8.639	0.059 ***Not significant***
	B	25	73.80	8.986	
DBP - 5	A	25	73.08	6.910	0.076 ***Not significant***
	B	25	69.52	6.953	
DBP - 10	A	25	68.08	5.852	0.299 ***Not significant***
	B	25	66.28	6.262	
DBP - 15	A	25	64.88	5.380	0.092 ***Not significant***
	B	25	62.32	5.129	
DBP - 20	A	25	62.32	4.039	0.211 ***Not significant***
	B	25	60.88	3.993	
DBP - 25	A	25	61.68	3.065	0.637 ***Not significant***
	B	25	61.28	2.880	
DBP - 30	A	25	61.36	3.475	0.400 ***Not significant***
	B	25	60.52	3.513	
DBP - 35	A	25	61.60	3.440	0.606 ***Not significant***
	B	25	62.20	4.646	
DBP - 40	A	25	62.36	3.882	0.213 ***Not significant***
	B	25	63.68	3.509	
DBP - 45	A	25	65.08	5.392	0.092 ***Not significant***
	B	25	67.64	5.139	
DBP - 50	A	25	68.72	6.141	0.245 ***Not significant***
	B	25	66.88	4.825	
DBP - 55	A	25	69.12	5.974	0.455 ***Not significant***
	B	25	68.00	4.416	
DBP - 60	A	25	65.40	4.311	0.520 ***Not significant***
	B	25	64.56	4.848	
DBP - 65	A	25	61.80	4.082	0.971 ***Not significant***
	B	25	61.84	3.727	
DBP - 70	A	25	62.12	4.003	0.226 ***Not significant***
	B	25	60.72	4.067	
DBP - 75	A	25	63.92	4.415	0.034 ***significant***
	B	25	67.04	5.623	
DBP - 80	A	25	61.96	2.835	0.669 ***Not significant***
	B	25	61.64	2.413	
DBP - 85	A	25	76.44	9.430	0.001 ***significant***
	B	25	66.04	5.741	
DBP - 90	A	25	69.00	6.151	0.116 ***Not significant***
	B	25	66.36	5.484	

Though the data is statistically significant at 75 and 85 mins both groups are comparable in terms of Diastolic Blood Pressure with no specific clinical significance.

TABLE 10: MEAN ARTERIAL PRESSURE:

	GROUP	N	Mean	SD	P value
MAP - Baseline	A	25	95.12	7.463	.052 ***Not significant***
	B	25	90.52	8.058	
MAP - 5	A	25	86.12	6.180	.001 ***significant***
	B	25	79.60	5.260	
MAP- 10	A	25	78.92	4.481	.026 ***significant***
	B	25	75.88	4.842	
MAP- 15	A	25	75.80	4.233	.344 ***Not significant***
	B	25	74.60	4.628	
MAP- 20	A	25	75.40	3.841	.376 ***Not significant***
	B	25	74.52	3.084	
MAP- 25	A	25	75.72	2.851	.187 ***Not significant***
	B	25	74.40	4.021	
MAP- 30	A	25	74.96	3.208	.177 ***Not significant***
	B	25	76.32	3.794	
MAP- 35	A	25	76.72	4.430	.786 ***Not significant***
	B	25	76.40	3.830	
MAP- 40	A	25	77.72	4.929	.653 ***Not significant***
	B	25	78.28	3.736	
MAP- 45	A	25	81.44	6.965	.716 ***Not significant***
	B	25	80.80	5.276	
MAP- 50	A	25	83.72	7.254	.034 ***Not significant***
	B	25	79.84	5.121	
MAP- 55	A	25	83.04	7.168	.534 ***Not significant***
	B	25	81.92	5.354	
MAP- 60	A	25	79.28	5.683	.468 ***Not significant***
	B	25	80.48	5.924	
MAP- 65	A	25	79.12	3.140	.874 ***Not significant***
	B	25	79.28	3.889	
MAP- 70	A	25	79.24	4.512	.402 ***Not significant***
	B	25	78.32	3.038	
MAP- 75	A	25	80.72	4.421	.123 ***Not significant***
	B	25	82.88	5.278	
MAP- 80	A	25	79.80	3.240	.860 ***Not significant***
	B	25	79.96	3.142	
MAP- 85	A	25	89.80	6.494	.001 ***significant***
	B	25	83.80	4.387	
MAP- 90	A	25	84.92	4.932	.842 ***Not significant***
	B	25	85.20	4.916	

Though the data is statistically significant at 5,10, and 85 mins both groups are comparable in terms of Mean Arterial Pressure with no specific clinical significance.

TABLE 11: RESPIRATORY RATE:

	GROUP	N	Mean	SD	P value
RR - Baseline	A	25	14.24	0.597	0.86
	B	25	14.2	0.645	***Not significant***
RR - 5	A	25	13.96	0.731	0.129
	B	25	14.4	0.645	***Not significant***
RR-10	A	25	13.96	0.789	0.130
	B	25	14.28	0.678	***Not significant***
RR-15	A	25	13.76	0.663	0.833
	B	25	14	0.778	***Not significant***
RR-20	A	25	13.76	0.778	1.000
	B	25	13.76	0.9	***Not significant***
RR-25	A	25	13.24	0.879	0.750
	B	25	13.32	0.723	***Not significant***
RR-30	A	25	13.56	0.820	0.365
	B	25	13.76	0.623	***Not significant***
RR-35	A	25	13.36	0.568	0.650
	B	25	13	0.577	***Not significant***
RR-40	A	25	13.4	0.645	0.255
	B	25	13.72	0.458	***Not significant***
RR-45	A	25	13.48	0.770	0.188
	B	25	13.76	0.925	***Not significant***
RR-50	A	25	13.52	0.871	0. 350
	B	25	14.08	0.812	***Not significant***
RR-55	A	25	13.96	0.934	0.630
	B	25	14.01	0.816	***Not significant***
RR-60	A	25	13.64	0.568	0.077
	B	25	14	0.707	***Not significant***
RR-65	A	25	13.76	0.925	0.308
	B	25	13.92	0.571	***Not significant***
RR-70	A	25	14.8	0.571	1.000
	B	25	14.08	0.568	***Not significant***
RR-75	A	25	13.72	0.541	0.612
	B	25	13.96	0.4	***Not significant***
RR-80	A	25	13.92	0.493	1.000
	B	25	13.92	0.483	***Not significant***
RR-85	A	25	13.84	0.687	0.163
	B	25	13.56	0.351	***Not significant***
RR-90	A	25	13.88	0.331	0.411
	B	25	13.96	0.358	***Not significant***

The data is statistically not significant ($p>0.05$) and this both groups are comparable in terms Respiratory Rate. There was no incidence of respiratory depression in both the groups.

TABLE 12: SPO_2 :

	GROUP	N	Mean	SD	P value
SPO_2 - Baseline	A	25	98.52	0.509	0.40
	B	25	98.64	0.48	***Not significant***
SPO_2 -5	A	25	98.44	0.506	0.263
	B	25	98.24	0.723	***Not significant***
SPO_2 -10	A	25	98.56	0.506	0.572
	B	25	98.64	0.48	***Not significant***
SPO_2-15	A	25	98.56	0.506	0.225
	B	25	98.36	0.637	***Not significant***
SPO_2-20	A	25	98.48	0.506	0.579
	B	25	98.64	0.48	***Not significant***
SPO_2-25	A	25	98.56	0.506	0.572
	B	25	98.53	0.489	***Not significant***
SPO_2-30	A	25	98.64	0.48	0.332
	B	25	98.34	0.653	***Not significant***
SPO_2-35	A	25	98.44	0.506	0.068
	B	25	98.36	0.068	***Not significant***
SPO_2-40	A	25	98.44	0.506	0.162
	B	25	98.64	0.48	***Not significant***
SPO_2-45	A	25	98.36	0.506	0.601
	B	25	98.45	0.583	***Not significant***
SPO_2-50	A	25	98.64	0.48	0.019
	B	25	98.45	0.583	***Not significant***
SPO_2-55	A	25	98.45	0.506	1.00
	B	25	98.56	0.506	***Not significant***
SPO_2-60	A	25	98.6	0.5	0.119
	B	25	98.36	0.568	***Not significant***
SPO_2-65	A	25	98.56	0.48	0.782
	B	25	98.52	0.509	***Not significant***
SPO_2-70	A	25	98.72	0.458	0.380
	B	25	98.6	0.5	***Not significant***
SPO_2-75	A	25	98.72	0.458	0.086
	B	25	98.48	0.509	***Not significant***
SPO_2-80	A	25	98.72	0.458	0.158
	B	25	98.48	0.509	***Not significant***
SPO_2-85	A	25	98.52	0.509	0.40
	B	25	98.64	0.48	***Not significant***
SPO_2-90	A	25	98.48	0.509	1.00
	B	25	98.48	0.48	***Not significant***

The data is statistically not significant ($p>0.05$) and this both groups are comparable in terms of SPO_2.

TABLE 13: CONVERSION TO GENERAL ANESTHESIA:

	Group	No	Yes	%	No	%	P value
Conversion to GA	A	25	2	8.0	23	92.0	1.000
	B	25	2	8.0	23	92.0	***Not significant***

The incidence of conversion to general anaesthesia is same, 8% in both the groups. Statistical analysis using chi square test reveals P value of 1.000, which is not significant.

TABLE 14: SIDE EFFECTS:

COMPLICATION	Group	No	Yes	%	No	%	P value
Nausea/Vomiting	A	25	2	8.0	23	92.0	1.000
	B	25	2	8.0	23	92.0	***Not significant***
Hypotension	A	25	2	8.0	23	92.0	0.637
	B	25	3	12.0	22	88.0	***Not significant***
Bradycardia	A	25	1	4.0	24	96.0	1.000
	B	25	1	4.0	24	96.0	***Not significant***
Shivering	A	25	8	32.0	17	68.0	0.002
	B	25	0	-	25	100	***significant***
Respiratory Depression	A	25	0	-	25	100	***Not significant***
	B	25	0	-	25	100	

The incidences of nausea/vomiting, hypotension, bradycardia, respiratory depression are comparable in both the groups. Statistical analysis is done using chi square test.

The incidence of shivering is 32% in group A vs 0% in group B. Chi square test reveals a P value of 0.002 which is statistically significant.

DISCUSSION

The primary aim of the study was to evaluate the effect of adding magnesium sulphate with bupivacaine in accelerating the onset of action for epidural anesthesia in patients coming for lower abdominal surgeries. The safety of adding magnesium sulphate in epidural route has been witnessed in previously done studies in humans by **TANMOY et al [8], A.BILIR et al [9],S.FAROUK [10]**. in the studies done by the above authors the dosage of magnesium sulphate used was 50 mg.

There are studies done in evaluating the effect of magnesium sulphate in spinal anesthesia by **M.OZALEVLI et al [13], ASOKKUMAR BUVENDRAN et al[14] and JONG WHA LEE et al[15]**. The dosage of magnesium sulphate used in these studies was 50 mg magnesium sulphate which showed no deleterious effect in humans.

There are studies done by **J.Y.HWANG et al [24], T.O.SEYHAN et al [31], N.M.ELSARHOUBY et al [32]** and many others were magnesium sulphate being evaluated at a dosage of 50 mg per kg intravenously with absolutely no complications.

SENSORY & MOTOR BLOCKADE:

In this study, the time for sensory blockade was 11.20 ± 2.179 in the Magnesium group (B) and 17.80 ± 2.533 in the control group (A) with a p value of <0.001 which showed statistical significance of early onset in the magnesium group.

The time for two segment motor regression 84.00 ± 7.5 in the magnesium group and 51.00 ± 7.50 in the control group with a p value of <0.001 which showed statistical significance of prolonged action in the magnesium group.

The above values of this study correlates with the study done by **TANMOY**[8] et al in which the onset of sensory blockade to in Magnesium Group 11.80 ± 3.21 minutes and in the control group it was 18.73 ± 2.79 minutes. The time for two segment regression was prolonged in the magnesium group and was found to be statistically significant.

The onset of action of this study correlates with the study done by **TANMOY**[8] et al, while the time for two segment regression was soon in this study. However this can be explained with the volume of Bupivacaine used in the study done by **TANMOY et al**[8] was more than this study.

The other studies done by **BILIR**[9] et al**, FAROUK**[10] et al support the analgesic effect of magnesium sulphate used in epidural route.

SIDE EFFECTS:

The incidence of nausea and vomiting was similar in both the groups .

The incidence of hypotension was similar in both the groups.

The incidence of bradycardia was similar in both the groups.

The incidence of shivering was reduced in the magnesium group with a p value <0.002. this finding correlates with the studies done by **TANMOY et al** [8] and **GODZEIMER et al** [39]

The incidence of respiratory depression was similar in both the groups.

SUMMARY

We conducted a randomised double blinded control study in a group of 50 patients belonging to ASA I and II undergoing elective lower abdominal surgeries to evaluate the effect of adding magnesium sulphate with injection bupivacaine in epidural anesthesia. Two groups of 25 each were randomly taken and analysed. The groups were comparable in terms of demographic profile.

The purpose of the study was to determine the time for onset of action of sensory and motor blockade. Data showed statistical significance of early onset of action in the magnesium group.

On the course of the study the time taken for two segment regression from the peak sensory level was found to be prolonged in the magnesium group. The obtained data showed statistical significance.

Also on the due course of the study it was found that the incidence of shivering was less in the patients belonging to the magnesium group compared to the control group which showed statistical significance.

Also epidural magnesium did not produce significant side effects in the study.

CONCLUSION

This study concludes that addition of epidural magnesium sulphate accelerates the onset of action of epidural bupivacaine and also prolongs the duration of action of epidural bupivacaine in patients coming for lower abdominal surgeries without increasing the incidence of side effects.

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PATIENT CONSENT FORM

Study title : **To evaluate magnesium sulphate in accelerating the onset of action of injection bupivacaine used for epidural anaesthesia**

Study centre : Institute of Anaesthesiology & Critical care,
Madras Medical College.

Participant name : Age:
O.P.No: Sex:

I confirm that I have understood the purpose of procedure for the above study . I have the opportunity to ask the question and all my questions and doubts have been answered to my satisfaction.

I have been explained about the pitfall in the procedure and in that case anaesthesia can be accomplished through general anaesthesia . I have been explained about the safety, advantage and disadvantage of the technique.

I understand that my participation in the study is voluntary and that i am free to withdraw at anytime without giving any reason.

I understand that investigator ,regulatory authorities and the ethics committee will not need my permission to look at my health records both in respect to current study and any further research that may be conducted in relation to it, even if I withdraw from the study . I understand that my identity will not be revealed in any information released to third parties or published , unless as required under the law . I agree not to restrict the use of any data or results that arise from the study .

I hereby consent to participate in this **study To evaluate magnesium sulphate in accelerating the onset of action of injection bupivacaine used for epidural anaesthesia**

Time:

Date: signature / thumb impression of patient

Place: patient name:

Signature of the investigator:

Name of the investigator:

PROFORMA

STUDY TO EVALUATE MAGNESIUM SULPHATE IN ACCELERATING THE ONSET OF ACTION OF INJECTION BUPIVACAINE USED FOR EPIDURAL ANAESTHESIA

NAME : AGE: SEX: I.P.No:

DIAGNOSIS: SURGERY PLANNED:

PREOPERATIVE ASSESSMENT:

HISTORY:

CO-MORBID ILLNESS & TREATMENT DETAILS:

EFFORT TOLERANCE- _____ METS

H/O PREVIOUS SURGERY :

GENERAL EXAMINATION:

HEIGHT: WEIGHT: BMI:

ANAEMIA- JAUNDICE- SPINE-

PULSE- BP- CVS- RS-

INVESTIGATIONS:

Hb : BT: CT:

BLOOD GROUPING&TYPING:

BLOOD SUGAR: UREA: CREATININE:

ECG: CXR:

EPIDURAL BLOCKADE:

SPACE	NEEDLE	SIZE	APPROACH	POSITION	TIME	DRUG

SENSORY BLOCK & MOTOR BLOCK:

	LEVEL	TIME
SENSORY		
MOTOR		

PEAK SENSORY BLOCKADE:

SENSORY BLOCK:

VAS SCORE:

0 – DOES NOT HURT

2 – HURTS JUST A LITTLE BIT

4 – HURTS A LITTLE MORE

6 – HURTS EVEN MORE

8 – HURTS A LOT

10 – HURTS AS MUCH AS U CAN IMAGINE

MOTOR BLOCK:

TIME TO REACH MOTOR BLOCK :

BROMAGE - 0 – no motor block

BROMAGE - 1 – inability to raise extended legs

BROMAGE - 2 – inability to flex knees

BROMAGE - 3 – inability to flex ankle joints

RAM TEST:

100% – able to raise from supine to sitting with hands behind head

80% – sit only with arms extended

60% – can lift only head and scapula

40% - can lift shoulders only off bed

20% - an increase in abdominal muscle tone can be felt during effort, no other response

INTRA OP VITAL PARAMETERS:

TIME	PR	SBP	DBP	MAP	SpO_2	RR	SIDE EFFECTS
Base line							
5 min							
10 min							
15min							
20min							
25min							
30min							
35min							
40min							
45min							
50min							
55min							
60min							

65min							
70min							
75min							
80min							
85min							
90min							

SIDE EFFECTS :

Side effects	
Nausea / vomiting	
Hypotension	
Bradycardia	
Shivering	
Need for intra op analgesia	
Respiratory depression	

INTRA OP EVENTS:

IV FLUIDS :

INJ.EPHEDRINE : DOSE TIME

INJ.ATROPINE (0.6 mg iv bolus) :

CONVERSION TO GA :

TIME FOR FIRST TWO SEGMENT REGRESSION (IN MINS):

S.NO	NAME	AGE	GROUP	SEX	I.P.NO.	ASA	BMI	ONSET OF SENSORY BLOCKADE IN MINUTES	ONSET OF MOTOR BLOCKADE IN MINUTES	TIME FOR TWO SEGMENT REGRESSION IN MINUTES	PEAK SENSORY BLOCKADE	RAMSAY SEDATION SCORE	CONVERSION TO GA	NAUSEA/VOMITING	HYPOTENSION	BRADYCARDIA	SHIVERING	RESPIRATORY DEPRESSION
1	ARUMUGAM	25	A	M	73839	1	21.6	15	20	45	T6	2	NO	NO	NO	NO	NO	NO
2	PUNITHA	48	A	F	73522	2	22.5	15	25	45	T6	2	NO	YES	NO	NO	YES	NO
3	RAJAVEL	18	A	M	74567	1	26.5	15	20	45	T6	2	NO	NO	NO	NO	YES	NO
4	ARJUN	40	A	M	74959	1	21.5	20	25	60	T6	2	NO	NO	NO	NO	YES	NO
5	KUMAR	52	A	M	73412	2	20.4	20	25	45	T6	2	YES	NO	NO	NO	NO	NO
6	VARALAKSHMI	35	A	F	73487	1	22.2	20	25	45	T6	2	NO	NO	NO	NO	NO	NO
7	RAMACHANDRAN	59	A	M	71344	2	24.9	15	20	45	T4	2	NO	NO	NO	NO	YES	NO
8	CHINAYAN	50	A	M	73376	1	21.5	20	20	60	T6	2	NO	NO	NO	NO	NO	NO
9	THANGARAJ	58	A	M	72052	2	23.5	15	20	60	T6	2	NO	YES	YES	NO	YES	NO
10	RAVI	35	A	M	75541	1	23.3	20	20	60	T6	2	NO	NO	NO	NO	NO	NO
11	SUSEELA	58	A	F	71414	2	24.1	20	25	45	T4	2	NO	NO	NO	NO	NO	NO
12	VIJAYAKUMAR	23	A	M	75943	1	22.8	15	20	45	T4	2	NO	NO	NO	NO	NO	NO
13	PRAKASH	25	A	M	75800	1	21.9	15	20	45	T6	2	NO	NO	NO	NO	NO	NO
14	KARTHIKEYAN	32	A	M	75160	1	22	20	20	60	T6	2	NO	NO	NO	NO	YES	NO
15	SHANTHI	49	A	F	75797	1	23.4	20	25	45	T4	2	YES	NO	NO	NO	YES	NO
16	KARUNAKARAN	50	A	M	77254	1	26	20	25	60	T6	2	NO	NO	NO	NO	NO	NO
17	VENDA	35	A	F	71111	1	22.4	20	20	45	T6	2	NO	NO	NO	NO	YES	NO
18	MURUGAN	25	A	M	75943	1	25	20	25	45	T4	2	NO	NO	NO	NO	NO	NO
19	ELUMALAI	25	A	M	71325	1	21.1	15	25	45	T6	2	NO	NO	NO	NO	NO	NO
20	MARIMUTHU	48	A	M	77542	1	23.7	20	25	45	T6	2	NO	NO	YES	NO	NO	NO
21	VARADHARAJAN	45	A	M	76139	1	21.3	15	25	60	T6	2	NO	NO	NO	NO	NO	NO
22	ARUMUGAM	49	A	M	77957	1	23.6	15	25	45	T6	2	NO	NO	NO	NO	NO	NO
23	NARESHKUMAR	27	A	M	72154	1	24.6	20	30	60	T6	2	NO	NO	NO	YES	NO	NO
24	RAMAN	40	A	M	79201	1	27.3	20	30	60	T6	2	NO	NO	NO	NO	NO	NO
25	SIVA	26	A	M	77281	1	23.5	15	30	60	T6	2	NO	NO	NO	NO	NO	NO

S.NO	NAME	AGE	GROUP	SEX	I.P.NO.	ASA	BMI	ONSET OF SENSORY BLOCKADE IN MINUTES	ONSET OF MOTOR BLOCK IN MINUTES	TIME FOR TWO SEGMENT REGRESSION IN MINUTES	PEAK SENSORY BLOCKADE	RAMSAY SEDATION SCORE	CONVERSION TO GA	NAUSEA/VOMITING	HYPOTENSION	BRADYCARDIA	SHIVERING	RESPIRATORY DEPRESSION
1	KANNAN	36	B	M	77567	1	22.2	10	10	75	T4	2	NO	YES	YES	NO	NO	NO
2	RAJENDRAN	40	B	M	77537	1	23.4	10	15	90	T4	2	NO	NO	NO	NO	NO	NO
3	RAJKUMAR	20	B	M	79397	1	25.1	10	15	75	T4	2	NO	NO	NO	NO	NO	NO
4	ALAGRAH	40	B	M	78498	1	21.9	10	15	90	T4	2	YES	NO	NO	YES	NO	NO
5	MUTHUSAMY	26	B	M	78651	1	22.4	15	15	75	T6	2	NO	NO	NO	NO	NO	NO
6	KARPAGAM	45	B	M	77984	1	22.3	10	15	75	T6	2	NO	NO	NO	NO	NO	NO
7	CHINNAPPA	51	B	M	77690	1	21.6	10	10	90	T6	2	NO	NO	NO	NO	NO	NO
8	ARUNACHALAM	57	B	M	76011	1	24.5	10	15	75	T6	2	NO	NO	NO	NO	NO	NO
9	PRAKASH	35	B	M	78331	1	21.5	10	15	75	T4	2	NO	NO	NO	NO	NO	NO
10	VEDHAM	59	B	F	76848	2	22.8	10	15	90	T4	2	NO	NO	YES	NO	NO	NO
11	ANNAMALAI	43	B	M	77541	1	23.4	10	15	75	T6	2	NO	NO	NO	NO	NO	NO
12	ROSY	24	B	F	78341	1	26.5	10	10	90	T6	2	NO	YES	YES	NO	NO	NO
13	SURESHBABU	35	B	M	76402	1	21	10	15	75	T6	2	NO	NO	NO	NO	NO	NO
14	DEVI	20	B	F	79118	1	9	15	15	90	T6	2	NO	NO	NO	NO	NO	NO
15	SARAVANNAN	42	B	M	79896	1	20.9	15	15	90	T6	2	NO	NO	NO	NO	NO	NO
16	PERUMAL	43	B	M	70597	1	24.1	15	15	90	T6	2	NO	NO	NO	NO	NO	NO
17	SHANTHI	47	B	F	80780	1	25	10	10	75	T6	2	NO	NO	NO	NO	NO	NO
18	GOVARDHAN	48	B	M	79576	1	23.8	10	10	90	T6	2	NO	NO	NO	NO	NO	NO
19	JAGANATHAN	40	B	M	79807	1	23.7	10	10	90	T6	2	NO	NO	NO	NO	NO	NO
20	SHANTHI	46	B	F	78773	1	24.6	10	10	90	T6	2	NO	NO	NO	NO	NO	NO
21	GOWTHAMAN	24	B	M	81999	1	22.5	15	20	90	T6	2	YES	NO	NO	NO	NO	NO
22	AYYANAR	40	B	M	79542	1	22.8	10	20	90	T6	2	NO	NO	NO	NO	NO	NO
23	MANI	55	B	M	79901	1	21.9	10	15	90	T6	2	NO	NO	NO	NO	NO	NO
24	ARJUNAN	45	B	M	88932	1	20.6	15	10	90	T6	2	NO	NO	NO	NO	NO	NO
25	DAYALAN	44	B	M	79512	1	26	10	15	75	T6	2	NO	NO	NO	NO	NO	NO

S.NO	SYSTOLIC BLOOD PRESSURE IN GROUP A (mm Hg)																		
	BASE LINE	5 MINS	10 MINS	15 MINS	20 MINS	25 MINS	30 MINS	35 MINS	40 MINS	45 MINS	50 MINS	55 MINS	60 MINS	65 MINS	70 MINS	75 MINS	80 MINS	85MINS	90 MINS
1	140	126	94	98	92	119	90	102	104	110	126	134	122	125	129	126	122	128	127
2	136	122	115	101	109	115	118	115	122	136	145	124	121	123	125	122	123	126	121
3	130	114	112	96	92	102	106	119	118	120	128	102	104	108	107	110	113	114	115
4	132	119	106	109	106	114	102	104	96	101	103	105	107	109	96	102	104	106	109
5	130	124	115	108	112	96	90	94	98	95	99	101	106	108	112	116	112	114	119
6	133	116	101	92	101	104	102	98	99	102	106	100	102	98	101	108	120	122	124
7	124	100	98	106	102	105	101	104	112	126	139	126	121	123	130	128	126	124	129
8	110	96	102	101	106	98	94	110	109	129	105	106	104	101	106	110	114	115	122
9	123	110	106	90	98	90	96	99	119	129	136	107	110	112	116	117	119	121	118
10	140	112	109	103	105	109	114	118	116	117	114	113	112	110	122	124	126	125	123
11	126	122	110	103	90	90	126	104	106	109	102	101	103	115	119	122	112	119	120
12	120	116	101	100	118	112	111	116	122	124	128	125	124	129	127	124	129	123	124
13	131	105	93	95	120	101	103	107	104	106	109	110	116	112	114	113	120	124	126
14	130	114	101	90	92	116	101	109	110	125	129	116	110	114	116	120	124	122	120
15	142	116	96	99	101	100	106	102	108	129	110	112	114	116	113	118	111	110	118
16	122	106	90	91	92	110	114	117	110	114	112	116	118	117	102	103	106	102	108
17	124	108	104	98	105	102	103	112	115	119	121	123	124	126	121	124	120	129	122
18	135	116	101	102	106	102	98	96	91	121	101	103	104	106	109	106	103	108	110
19	126	101	102	100	94	98	96	126	103	101	102	106	108	109	110	112	111	108	104
20	110	108	90	91	115	98	92	96	104	90	94	92	101	100	102	98	106	104	102
21	115	114	106	104	99	92	94	91	101	104	102	101	104	117	114	115	118	122	128
22	124	113	110	109	101	102	104	110	126	129	119	124	122	121	126	120	127	125	123
23	118	106	93	92	90	116	115	124	128	135	114	117	120	121	124	126	128	124	121
24	142	124	112	106	104	102	107	108	104	103	106	104	102	108	109	110	101	104	110
25	136	126	101	112	103	110	112	117	116	113	114	115	112	114	117	112	116	114	122

S.NO	SYSTOLIC BLOOD PRESSURE IN GROUP B (mm Hg)																		
	BASE LINE	5 MINS	10 MINS	15 MINS	20 MINS	25 MINS	30 MINS	35 MINS	40 MINS	45 MINS	50 MINS	55 MINS	60 MINS	65 MINS	70 MINS	75 MINS	80 MINS	85MINS	90 MINS
1	119	101	90	98	90	96	99	106	101	104	107	110	112	116	117	119	121	122	129
2	122	125	103	105	109	114	118	116	117	114	113	112	110	122	124	126	125	122	126
3	146	104	103	90	90	126	104	106	109	102	101	103	115	119	122	112	119	120	115
4	114	99	100	118	112	111	116	122	124	128	125	124	129	127	124	129	123	121	123
5	124	102	95	120	101	103	107	104	106	109	110	116	112	114	113	120	124	127	129
6	129	104	90	92	116	101	109	110	115	119	116	110	114	116	120	124	122	119	118
7	119	114	99	101	100	106	102	108	109	110	112	114	116	113	118	111	110	112	114
8	126	102	91	92	110	114	117	110	114	112	116	118	117	102	103	106	102	116	113
9	124	101	98	105	102	103	112	115	119	121	123	124	126	121	124	120	129	122	124
10	122	96	102	106	102	98	96	91	121	101	103	104	106	109	106	103	108	124	129
11	134	112	100	94	98	96	126	103	101	102	106	108	109	110	112	111	108	116	119
12	127	101	91	115	98	92	96	104	90	94	92	101	100	102	98	106	126	132	134
13	126	93	104	99	92	94	91	101	104	102	101	104	117	114	115	118	122	126	132
14	124	98	109	101	102	104	110	114	116	119	124	122	121	126	120	127	125	122	125
15	122	91	92	90	116	115	114	112	119	114	117	120	121	124	126	128	124	121	120
16	118	102	106	104	102	107	108	104	103	106	104	102	108	109	110	101	104	123	136
17	117	98	90	103	110	112	117	116	113	114	115	112	114	117	112	116	114	112	118
18	128	94	102	106	110	117	107	105	102	106	108	103	107	108	109	105	104	115	119
19	126	99	90	92	110	92	94	110	117	112	115	138	145	110	112	114	116	113	128
20	138	104	92	106	108	102	99	104	109	107	116	121	124	129	121	132	134	140	142
21	121	118	100	101	99	94	106	108	104	102	101	114	118	119	112	118	127	124	126
22	124	107	105	94	96	98	99	98	101	98	104	105	98	106	102	104	108	112	118
23	104	102	96	98	93	94	95	97	92	104	102	98	104	103	101	105	109	116	124
24	128	121	101	106	98	94	110	109	108	105	106	104	101	106	110	114	115	109	110
25	119	101	90	98	90	96	99	106	101	104	107	110	112	116	117	119	121	122	129

S. NO	DIASTOLIC BLOOD PRESSURE in Group A (mm Hg)																		
	BASELINE	5 MINS	10MINS	15 MINS	20 MINS	25 MINS	30 MINS	35 MINS	40 MINS	45 MINS	50 MINS	55 MINS	60 MINS	65 MINS	70 MINS	75 MINS	80 MINS	85 MINS	90 MINS
1	92	88	75	56	58	56	64	62	60	61	62	60	64	60	68	64	63	62	61
2	86	76	74	69	66	64	70	68	64	69	74	72	68	61	64	62	62	69	64
3	84	70	62	66	64	62	64	62	63	72	70	74	71	55	63	62	64	66	71
4	80	73	72	64	68	64	69	62	61	65	68	66	66	60	61	59	68	86	77
5	76	71	60	76	72	68	63	59	55	59	58	62	68	68	55	61	61	82	69
6	70	69	64	66	62	61	60	61	60	62	64	68	64	64	60	61	63	79	75
7	66	66	60	68	64	63	62	61	68	63	69	76	62	58	68	58	60	92	72
8	69	70	58	64	63	60	60	58	64	66	72	70	74	69	64	54	59	74	68
9	66	64	66	62	58	59	56	54	58	62	70	74	70	62	58	64	64	66	64
10	86	80	62	74	66	64	62	64	69	70	69	72	69	68	69	63	63	84	78
11	82	80	64	70	68	63	61	63	62	65	68	66	60	62	62	69	66	80	72
12	79	74	74	69	61	66	60	69	68	74	72	75	69	63	68	64	64	66	68
13	92	70	72	60	58	64	62	64	62	60	64	69	63	64	62	61	58	82	70
14	74	70	71	69	61	58	63	61	63	64	71	76	62	66	63	62	62	77	80
15	66	64	68	63	60	62	61	62	64	68	74	70	65	63	64	68	55	74	66
16	84	78	62	62	59	55	60	68	66	64	68	64	62	59	66	64	61	76	62
17	80	82	64	56	59	61	61	64	63	66	72	76	64	64	63	66	64	87	67
18	66	61	71	62	63	64	62	58	59	54	74	72	56	59	59	68	59	96	69
19	82	64	77	64	60	59	60	59	64	60	63	66	74	54	64	64	62	81	59
20	77	69	69	56	55	62	59	62	59	62	60	55	64	62	59	62	65	62	79
21	74	72	75	74	69	65	56	58	54	60	61	62	65	60	54	74	60	60	68
22	76	74	72	64	61	60	54	58	62	73	78	72	61	61	60	70	58	72	74
23	87	83	68	65	62	58	60	62	60	78	86	80	62	55	56	69	62	78	72
24	96	82	64	62	61	62	61	60	62	64	66	63	68	60	62	60	62	83	62
25	81	77	78	61	60	62	64	61	69	66	65	68	64	68	61	69	64	77	58

S.NO	DIASTOLIC BLOOD PRESSURE in Group B (mm Hg)																		
	BASELINE	5 MINS	10MINS	15 MINS	20 MINS	25 MINS	30 MINS	35 MINS	40 MINS	45 MINS	50 MINS	55 MINS	60 MINS	65 MINS	70 MINS	75 MINS	80 MINS	85 MINS	90 MINS
1	75	65	68	58	57	59	55	59	62	67	64	63	62	59	54	78	62	67	68
2	64	60	74	61	64	62	64	61	63	70	69	66	68	64	60	63	58	75	58
3	87	81	72	69	62	58	68	66	62	68	66	64	60	59	61	62	62	71	59
4	81	73	62	66	63	62	60	64	61	69	72	70	64	54	64	61	60	68	64
5	64	62	58	59	61	60	61	65	64	68	66	68	66	62	66	64	64	66	74
6	61	60	62	57	60	64	63	68	66	71	76	72	64	60	62	68	62	87	75
7	67	68	64	60	59	62	60	61	63	66	70	71	60	61	55	61	58	66	73
8	75	64	59	61	54	58	66	64	68	74	73	74	61	55	64	64	60	68	65
9	71	68	62	60	58	60	64	68	66	71	68	72	63	60	61	69	61	64	66
10	68	68	60	64	62	61	58	52	51	78	74	71	62	68	66	66	63	58	63
11	91	78	74	75	70	63	59	69	64	60	62	74	72	64	56	72	62	69	62
12	87	81	72	73	72	62	54	59	63	56	58	62	61	58	60	66	58	62	72
13	84	80	64	62	60	58	55	56	61	64	62	68	66	69	60	76	61	68	61
14	72	73	63	61	62	61	59	64	62	69	70	72	62	62	58	70	66	62	66
15	74	70	60	54	55	66	64	68	67	72	70	74	64	68	55	73	62	63	62
16	62	64	68	62	60	62	63	65	64	68	64	68	63	62	64	68	64	64	64
17	64	61	58	59	62	64	62	67	69	77	72	69	64	63	68	74	63	66	63
18	86	77	59	61	60	63	61	64	63	68	69	72	68	64	60	62	64	63	64
19	63	60	64	55	58	64	59	56	66	72	71	71	72	66	61	58	68	59	68
20	82	79	74	65	64	68	62	54	62	64	66	64	77	63	63	62	60	64	72
21	78	72	75	69	62	60	61	64	67	66	64	63	74	59	60	70	61	67	77
22	74	70	73	65	60	61	62	61	64	63	60	62	61	64	66	64	61	62	74
23	64	63	65	60	58	54	60	58	68	60	61	59	61	60	64	62	60	64	61
24	76	72	79	64	62	61	58	63	64	63	61	68	57	63	56	65	59	61	60
25	75	69	68	58	57	59	55	59	62	67	64	63	62	59	54	78	62	67	68

S. NO	MEAN ARTERIAL PRESSURE in Group A (mm Hg)																		
	BASELINE	5 MINS	10 MINS	15 MINS	20 MINS	25 MINS	30 MINS	35 MINS	40 MINS	45 MINS	50 MINS	55 MINS	60 MINS	65 MINS	70 MINS	75 MINS	80 MINS	85 MINS	90 MINS
1	108	100	78	70	69	77	72	73	74	77	83	84	83	83	81	84	82	84	83
2	102	91	87	79	80	81	82	83	83	90	98	89	85	81	86	82	82	88	83
3	99	84	78	76	73	75	78	82	81	88	89	83	82	72	77	78	80	82	85
4	97	88	83	76	80	80	80	78	72	77	79	79	79	76	72	73	80	92	87
5	94	88	78	78	85	77	72	72	69	71	71	75	80	81	74	79	78	92	85
6	91	84	76	74	75	75	74	70	73	75	78	78	76	75	73	76	82	93	91
7	85	77	72	79	76	77	75	76	82	84	92	92	81	79	88	81	82	102	91
8	82	78	72	76	77	72	71	76	79	87	83	82	84	79	78	72	77	87	86
9	85	79	79	71	71	70	78	72	78	84	92	85	83	78	81	81	82	84	82
10	104	90	77	83	79	79	79	74	84	85	84	85	83	82	86	83	84	97	93
11	96	94	79	82	75	72	76	76	76	79	79	77	74	79	81	86	81	93	88
12	92	88	83	79	80	81	74	84	86	90	90	91	57	85	88	84	85	85	86
13	105	81	75	71	78	76	75	78	76	75	79	82	80	80	79	78	78	96	80
14	92	84	77	76	71	77	74	77	78	88	90	89	78	82	80	81	82	92	93
15	91	81	77	75	74	74	75	75	78	85	86	84	81	80	80	84	73	86	83
16	96	87	71	71	70	73	78	84	80	79	82	81	80	78	78	77	76	84	77
17	94	90	77	70	74	74	77	80	80	82	88	91	84	84	82	85	82	101	85
18	89	79	81	75	77	76	73	70	69	76	83	82	72	74	75	80	73	100	82
19	96	76	85	76	71	72	72	82	77	73	76	79	85	77	79	80	78	90	74
20	88	82	76	67	75	74	70	75	74	71	71	67	76	78	73	74	78	76	86
21	87	86	85	84	79	74	71	69	69	74	74	65	78	79	74	87	79	80	88
22	92	87	86	79	76	77	70	75	83	91	91	89	81	81	82	86	81	89	90
23	103	90	76	74	71	77	78	82	82	97	95	92	81	82	78	88	84	93	88
24	111	96	80	76	75	75	75	77	76	77	79	92	79	77	77	76	75	90	78
25	99	93	85	78	74	78	75	78	84	81	81	83	80	76	79	83	81	89	79

S. NO	MEAN ARTERIAL PRESSURE in Group B (mm Hg)																		
	BASELINE	5 MINS	10 MINS	15 MINS	20 MINS	25 MINS	30 MINS	35 MINS	40 MINS	45 MINS	50 MINS	55 MINS	60 MINS	65 MINS	70 MINS	75 MINS	80 MINS	85 MINS	90 MINS
1	99	77	75	71	74	71	78	76	75	79	78	78	79	78	75	91	81	85	88
2	83	81	77	75	79	79	81	78	81	84	83	81	77	85	81	84	80	90	80
3	106	86	82	76	70	81	76	76	81	79	77	77	74	79	81	78	81	87	77
4	92	81	74	83	78	78	78	84	82	88	89	88	88	78	84	83	81	85	83
5	84	75	70	76	74	74	76	75	78	81	80	84	79	79	81	82	84	86	92
6	83	74	71	68	78	76	78	76	82	87	74	84	80	78	81	86	82	97	89
7	84	83	75	73	72	76	77	78	78	80	88	85	81	78	76	77	75	81	86
8	92	76	69	71	72	74	83	79	83	86	84	86	79	74	77	78	74	84	81
9	88	79	74	75	72	72	80	76	83	87	86	89	84	81	82	86	83	83	85
10	86	77	74	78	75	73	70	65	74	85	83	82	75	77	79	78	78	80	85
11	105	89	84	74	80	74	80	74	76	74	76	85	84	79	74	85	77	84	81
12	100	87	78	87	80	72	76	75	72	68	69	75	74	77	72	79	80	85	92
13	98	87	77	74	70	70	67	74	75	76	74	80	83	81	78	90	81	87	84
14	89	72	78	74	74	75	76	80	80	85	85	85	81	89	78	89	85	82	85
15	90	77	70	66	75	82	80	82	84	86	78	89	82	85	79	91	82	82	81
16	80	76	80	76	74	77	78	78	77	80	77	76	78	77	80	79	77	83	88
17	79	73	68	73	77	80	80	83	83	89	86	77	80	81	81	88	80	81	81
18	100	75	72	76	76	81	77	76	76	80	82	78	81	78	79	76	77	80	82
19	84	73	72	67	75	73	78	77	83	85	85	93	96	80	80	76	84	77	88
20	100	80	76	78	78	70	74	74	77	78	82	89	92	86	82	85	84	89	95
21	92	87	83	79	74	71	73	78	79	79	76	82	88	81	77	86	83	86	93
22	90	82	85	74	72	73	72	73	76	74	77	78	73	77	76	77	76	78	88
23	77	76	75	72	71	67	71	72	72	77	74	72	75	75	76	76	76	81	82
24	93	88	83	78	73	70	77	77	77	78	76	76	71	78	74	81	77	77	76
25	89	79	75	71	70	71	72	74	73	75	77	79	78	71	75	91	81	85	88

S. NO	HEART RATE- A GROUP																		
	BASELINE	5 MIN	10 MINS	15MINS	20 MINS	25 MINS	30 MINS	35 MINS	40 MINS	45 MINS	50 MINS	55 MINS	60 MINS	65 MINS	70 MINS	75 MINS	80 MINS	85 MINS	90 MINS
1	76	76	72	74	65	60	55	52	60	62	74	69	66	67	66	74	75	60	68
2	78	79	82	78	74	74	75	78	79	80	86	66	68	65	64	74	70	70	74
3	87	84	64	66	81	86	83	84	82	76	87	80	87	64	68	65	68	74	72
4	95	86	67	79	62	65	67	60	56	52	106	87	81	62	69	69	69	82	85
5	109	87	69	85	71	72	75	74	71	78	110	102	76	75	77	70	63	56	84
6	101	70	64	75	70	74	75	81	82	85	89	88	90	85	90	81	62	64	68
7	79	70	71	87	66	64	68	60	56	84	86	80	86	84	73	74	64	74	70
8	108	66	74	75	71	76	75	74	72	80	66	69	69	60	69	66	67	75	73
9	79	64	74	70	74	75	81	82	85	84	64	62	60	70	66	68	65	52	60
10	85	68	65	68	64	68	60	56	84	89	71	76	75	74	80	87	64	78	79
11	86	69	69	69	75	68	69	64	68	71	74	75	81	82	87	81	62	84	82
12	103	77	70	63	74	75	81	82	85	84	64	68	60	56	102	76	75	60	56
13	92	90	81	62	64	68	60	56	84	89	75	68	69	64	88	90	85	74	71
14	90	73	74	64	75	68	69	64	68	71	72	75	71	74	80	86	84	81	82
15	101	69	66	67	84	86	74	76	67	75	70	79	78	66	73	71	62	60	56
16	86	66	68	65	85	80	76	84	72	78	65	60	55	52	60	62	72	74	72
17	87	80	87	64	84	86	88	89	80	88	74	74	75	78	79	80	70	82	85
18	106	87	81	62	69	69	60	68	62	79	81	86	83	84	82	76	65	56	84
19	110	102	76	75	62	60	70	74	72	74	62	65	67	60	56	52	74	64	68
20	89	88	90	85	70	64	75	70	74	71	71	72	75	74	71	78	81	82	85
21	86	80	86	84	70	71	87	66	64	84	70	74	75	81	82	85	62	56	84
22	85	87	78	68	66	74	75	71	76	89	66	64	68	60	56	84	71	64	68
23	87	85	77	71	64	74	70	74	75	71	71	76	75	74	72	80	70	76	67
24	74	75	81	82	85	65	68	64	68	95	60	68	62	79	81	86	82	84	72
25	64	68	60	56	84	69	69	75	68	67	70	74	72	92	62	65	81	89	80

S. NO	HEART RATE- B GROUP																		
	BASELINE	5 MIN	10 MINS	15MINS	20 MINS	25 MINS	30 MINS	35 MINS	40 MINS	45 MINS	50 MINS	55 MINS	60 MINS	65 MINS	70 MINS	75 MINS	80 MINS	85 MINS	90 MINS
1	105	90	75	72	78	70	75	71	75	76	74	66	64	66	70	72	79	78	74
2	82	84	66	70	66	61	84	74	68	62	61	60	86	88	76	74	80	74	75
3	96	89	82	79	85	84	84	86	74	76	67	65	62	66	75	74	75	82	82
4	95	84	86	85	90	84	85	80	76	84	72	71	75	76	72	71	60	66	72
5	115	90	84	84	85	87	84	86	88	89	80	82	81	78	79	78	80	81	80
6	76	70	89	64	63	66	69	69	60	68	62	68	69	70	72	74	72	70	74
7	86	83	82	68	68	64	62	60	70	74	72	85	89	82	81	88	85	86	84
8	92	80	71	76	74	71	76	75	74	72	80	76	73	79	71	76	70	85	86
9	78	81	76	72	70	74	75	81	82	85	84	86	89	82	86	85	84	80	81
10	102	100	70	71	66	64	68	60	56	84	89	86	76	74	75	70	68	70	72
11	91	90	85	69	71	75	68	69	64	68	71	72	67	65	66	62	69	68	70
12	83	85	75	84	74	72	75	71	74	70	75	79	78	76	85	82	81	80	75
13	88	86	92	72	71	70	79	78	75	73	74	76	79	74	72	79	75	72	71
14	80	81	82	68	64	65	60	55	52	60	62	69	60	54	52	50	52	53	51
15	72	80	70	70	75	74	74	75	78	79	80	80	79	84	82	81	83	86	81
16	110	88	86	72	81	81	86	83	84	82	76	79	81	83	72	71	74	76	75
17	75	70	66	60	64	62	65	67	60	56	52	68	75	73	69	64	68	69	71
18	72	78	74	76	69	71	72	75	74	71	78	79	75	76	71	70	78	75	78
19	95	72	68	71	75	70	74	75	81	82	85	84	86	89	82	86	85	84	80
20	83	88	72	70	72	66	64	68	60	56	84	89	86	76	74	75	70	68	70
21	109	88	70	85	74	71	76	75	74	72	80	76	73	79	71	76	70	85	84
22	81	74	62	66	70	74	75	81	82	85	84	86	89	82	86	85	84	80	84
23	86	83	81	80	66	64	56	55	56	53	99	105	96	92	84	82	81	73	74
24	92	82	82	83	71	75	68	69	64	68	71	72	67	65	66	62	69	68	69
25	89	73	71	70	84	84	86	74	76	67	95	86	67	79	79	75	76	67	60

S. NO	RESPIRATORY RATE (per MIN)-GROUP A																		
	BASE LINE	5 MINS	10 MINS	15 MINS	20 MINS	25 MINS	30 MINS	35 MINS	40 MINS	45 MINS	50 MINS	55 MINS	60 MINS	65 MINS	70 MINS	75 MINS	80 MINS	85MINS	90 MINS
1	14	15	15	14	13	12	12	13	13	12	12	14	13	14	15	13	15	15	14
2	13	12	14	13	14	12	14	12	12	13	14	12	13	15	14	12	13	12	13
3	14	14	13	13	15	12	14	13	14	14	13	15	14	15	14	14	14	14	14
4	15	14	14	14	13	14	13	14	13	14	14	15	14	14	14	14	14	14	14
5	14	15	14	15	14	14	15	13	15	14	15	12	14	14	15	14	13	12	14
6	14	14	13	13	12	13	12	13	13	12	13	12	12	12	13	13	14	13	14
7	14	14	13	13	15	12	14	13	14	14	13	15	14	15	14	14	14	14	14
8	14	15	15	14	13	12	12	13	13	12	12	14	13	14	15	13	15	15	14
9	15	14	15	13	14	13	12	13	13	14	15	14	13	13	13	14	13	14	13
10	15	14	15	14	13	14	14	14	13	12	14	14	13	12	14	13	14	14	13
11	15	14	13	15	14	13	14	13	14	13	13	14	13	14	13	14	13	14	14
12	14	13	14	13	14	13	14	13	14	13	13	14	14	14	14	14	14	14	14
13	14	13	14	14	14	14	14	13	13	14	14	14	14	14	14	14	14	14	14
14	15	14	14	14	14	14	14	14	13	14	12	13	14	13	14	14	14	14	14
15	14	14	14	14	14	14	14	14	14	14	15	14	14	14	14	14	14	14	14
16	14	14	13	13	15	12	14	13	14	14	13	15	14	15	14	14	14	14	14
17	15	14	14	14	13	14	13	14	13	14	14	15	14	14	14	14	14	14	14
18	14	15	14	14	14	14	14	14	13	13	14	14	14	13	14	14	14	14	14
19	13	13	13	13	13	14	14	14	13	14	14	13	13	13	13	14	14	14	14
20	14	14	14	14	13	13	13	13	13	13	14	14	14	13	14	13	14	13	14
21	14	15	14	14	14	14	14	13	13	14	14	14	14	12	13	14	14	14	14
22	15	13	16	15	14	14	14	14	14	14	13	14	14	14	14	14	14	14	14
23	14	14	14	14	14	14	14	14	14	14	13	14	14	14	14	14	14	14	14
24	14	14	13	13	15	12	14	13	14	14	13	15	14	15	14	14	14	14	14
25	15	14	14	14	13	14	13	14	13	14	14	15	14	14	14	14	14	14	14

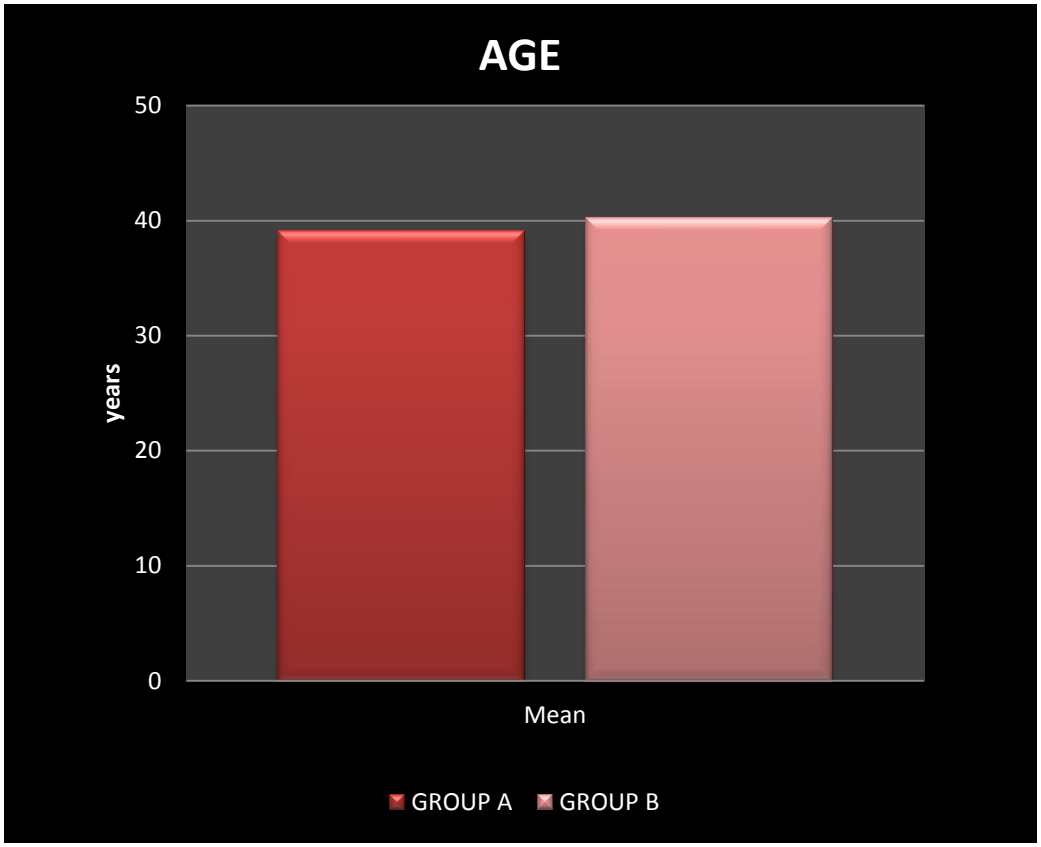
S. NO.							RESPIRATORY RATE GROUPB												
	BASE LINE	5 MINS	10 MINS	15 MINS	20 MINS	25 MINS	30 MINS	35 MINS	40 MINS	45 MINS	50 MINS	55 MINS	60 MINS	65 MINS	70 MINS	75 MINS	80 MINS	85MINS	90 MINS
1	14	14	14	14	14	13	13	14	13	14	14	13	14	13	14	13	14	14	15
2	15	14	14	14	14	13	13	14	14	14	14	14	15	14	13	14	14	14	14
3	15	14	14	14	14	13	13	14	14	14	13	14	13	14	14	13	14	14	14
4	14	14	14	14	14	14	14	14	14	13	15	15	15	14	14	14	14	14	14
5	14	15	15	15	15	14	14	14	14	14	14	14	14	14	14	14	14	14	14
6	14	15	15	15	15	15	15	13	13	13	12	15	13	14	13	15	15	15	15
7	14	14	13	13	15	12	14	13	14	14	13	15	14	15	14	14	14	14	14
8	15	14	14	14	13	14	13	14	13	14	14	15	14	14	14	14	14	14	14
9	15	14	14	14	14	14	14	14	13	14	12	13	14	13	14	14	14	14	14
10	14	14	14	14	14	14	14	14	14	14	15	14	14	14	14	14	14	14	14
11	14	15	15	14	14	14	14	14	14	14	12	13	14	15	14	14	14	15	14
12	13	15	13	14	14	14	13	13	13	13	14	14	13	14	13	14	14	14	14
13	14	16	15	15	12	12	12	13	13	14	14	12	12	13	14	14	14	14	14
14	15	15	15	15	15	14	14	14	14	14	15	15	15	15	15	14	14	14	14
15	16	14	14	15	15	15	15	15	15	14	14	14	14	14	14	14	14	14	14
16	14	14	14	14	14	14	13	14	14	13	14	14	14	13	14	14	14	13	14
17	14	14	15	15	15	15	14	14	14	14	14	15	15	15	15	15	15	14	14
18	14	15	15	14	14	14	14	14	13	14	14	14	15	15	15	15	15	15	14
19	14	14	14	15	15	15	14	15	13	14	14	14	15	15	14	14	14	14	13
20	14	14	14	14	14	14	14	14	14	13	15	15	15	14	14	14	14	14	14
21	14	15	15	15	15	14	14	14	14	14	14	14	14	14	14	14	14	14	14
22	14	15	15	15	15	15	15	13	13	13	12	15	13	14	13	15	15	15	15
23	13	13	13	13	13	14	14	14	13	14	14	13	13	13	13	14	14	14	14
24	14	14	14	14	13	13	13	13	13	13	14	14	14	13	14	13	14	13	14
25	14	14	14	13	14	13	14	13	14	14	14	14	14	14	14	13	14	14	14

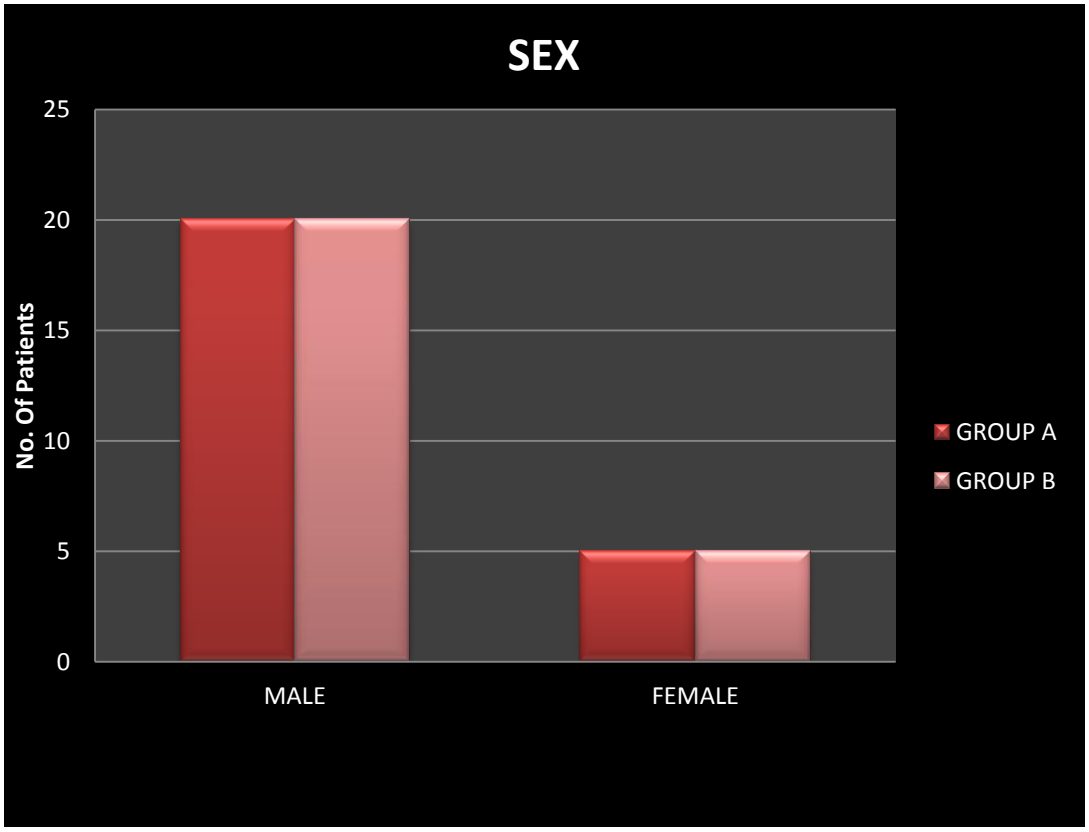
S.NO	PAIN SCORE GROUP-A											RAM SCORE (in %) GROUP A					
	5 MINS	10 MINS	15 MINS	20 MINS	25 MINS	30 MINS	45 MINS	60 MINS	75 MINS	90MINS	105 MINS	5 MINS	10 MINS	15 MINS	20 MINS	25 MINS	30 MINS
1		2	0	0	0	0	2					100	100	80	60		
2		2	0	0	0	0	2					100	100	80	80	60	
3		2	0	0	0	0	2					100	80	80	60		
4			2	0	0	0	0	2				100	100	80	80	60	
5			2	0	0	0	2					100	100	80	80	60	
6			2	0	0	0	2					100	100	80	80	60	
7		2	0	0	0	0	0	2				100	100	80	60		
8			2	0	0	0	0	2				100	100	80	60		
9		2	0	0	0	0	0	2				100	80	80	60		
10			2	0	0	0	0	2				100	80	80	60		
11			2	0	0	0	0	2				100	100	80	80	60	
12		2	0	0	0	0	0	2				100	100	80	60		
13		2	0	0	0	0	2					100	80	80	60		
14			2	0	0	0	0	2				100	80	80	60		
15			2	0	0	0	0	2				100	100	80	80	60	
16			2	0	0	0	0	2				100	100	80	80	60	
17			2	0	0	0	2					100	100	80	60		
18			2	0	0	0	0	2				100	100	80	80	60	
19		2	0	0	0	0	2					100	100	80	80	60	
20			2	0	0	0	2					100	100	80	80	60	
21		2	0	0	0	0	0	2				100	100	80	80	60	
22		2	0	0	0	0	2					100	100	80	80	60	
23			2	0	0	0	0	2				100	100	80	80	80	60
24			2	0	0	0	0	2				100	100	80	80	80	60
25		2	0	0	0	0	0	2				100	100	80	80	80	60

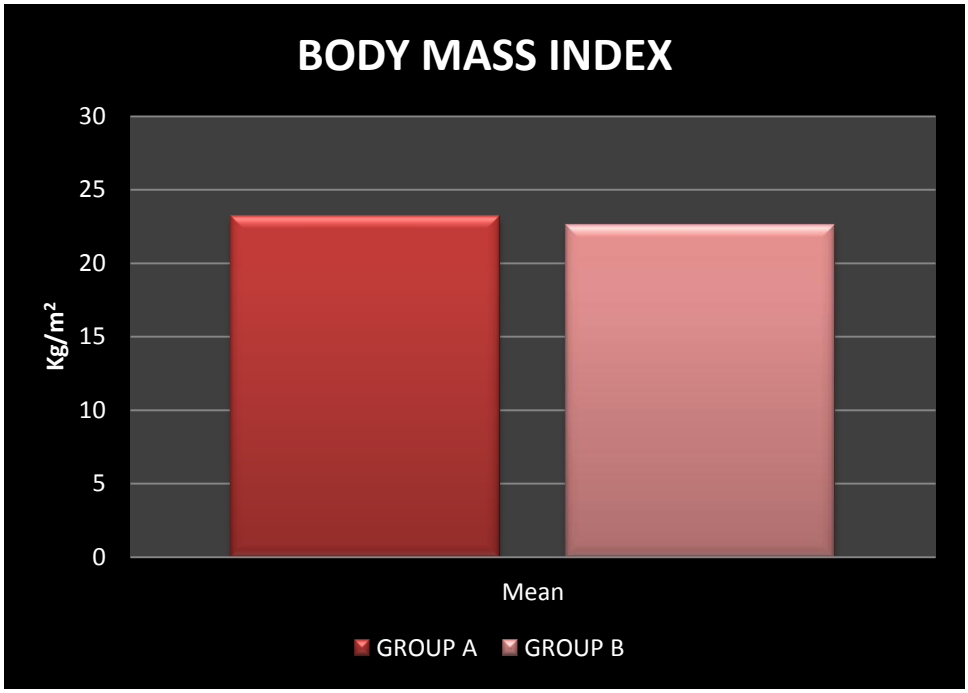
S.NO	PAIN SCORE GROUP B											RAM SCORE (in %) GROUP B					
	5 MINS	10 MINS	15 MINS	20 MINS	25 MINS	30 MINS	45 MINS	60 MINS	75 MINS	90MINS	105 MINS	5 MINS	10 MINS	15 MINS	20 MINS	25 MINS	30 MINS
1	2	0	0	0	0	0	0	0	0	2		80	60				
2	2	0	0	0	0	0	0	0	0	0	2	80	80	60			
3	2	0	0	0	0	0	0	0	0	2		80	80	60			
4	2	0	0	0	0	0	0	0	0	0	2	80	80	60			
5		2	0	0	0	0	0	0	2			80	80	60			
6	2	0	0	0	0	0	0	0	2			80	80	60			
7	2	0	0	0	0	0	0	0	0	2		80	60				
8	2	0	0	0	0	0	0	0	2			100	80	60			
9	2	0	0	0	0	0	0	0	0	2		80	80	60			
10	2	0	0	0	0	0	0	0	0	0	2	80	80	60			
11	2	0	0	0	0	0	0	0	2			80	80	60			
12	2	0	0	0	0	0	0	0	0	2		80	60				
13	2	0	0	0	0	0	0	0	2			100	80	60			
14		2	0	0	0	0	0	0	0	2		80	80	60			
15		2	0	0	0	0	0	0	0	2		80	80	60			
16		2	0	0	0	0	0	0	0	2		80	80	60			
17	2	0	0	0	0	0	0	0	2			80	60				
18	2	0	0	0	0	0	0	0	0	2		80	60				
19	2	0	0	0	0	0	0	0	0	2		80	60				
20	2	0	0	0	0	0	0	0	0	2		80	60				
21		2	0	0	0	0	0	0	0	2		100	80	80	60		
22	2	0	0	0	0	0	0	0	0	2		100	80	80	60		
23	2	0	0	0	0	0	0	0	0	2		80	80	60			
24		2	0	0	0	0	0	0	0	2		80	60				
25	2	0	0	0	0	0	0	0	2			80	80	60			

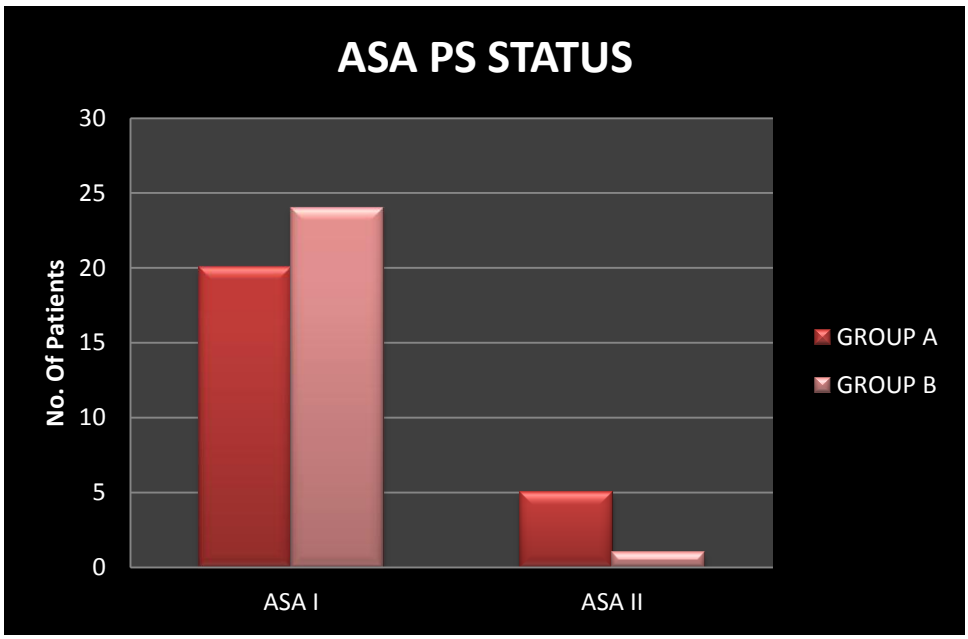
S. NO	SPO2 % (GROUP A)																		
	BASE LINE	5 MINS	10 MINS	15 MINS	20 MINS	25 MINS	30 MINS	35 MINS	40 MINS	45 MINS	50 MINS	55 MINS	60 MINS	65 MINS	70 MINS	75 MINS	80 MINS	85MINS	90 MINS
1	98	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
2	99	99	99	99	99	99	99	99	99	98	99	99	99	99	99	99	99	99	98
3	98	99	99	99	99	99	99	99	98	98	98	98	98	98	98	98	98	98	98
4	99	99	99	99	99	99	99	99	99	98	99	99	99	99	99	99	99	99	99
5	99	99	99	99	99	99	99	99	98	99	99	99	99	99	99	99	99	99	98
6	99	99	99	99	99	99	99	99	98	98	98	98	98	98	98	98	98	98	98
7	98	98	98	98	98	98	98	98	98	99	99	99	99	99	99	99	99	99	98
8	99	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
9	98	98	98	98	98	98	98	98	99	99	99	99	99	99	99	99	99	99	99
10	99	98	99	99	99	99	99	99	98	98	99	99	99	99	99	99	99	99	99
11	98	98	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
12	99	98	99	99	99	99	99	99	98	98	99	99	98	98	98	98	98	98	98
13	98	99	99	99	99	99	99	99	98	99	99	99	99	99	99	99	99	98	99
14	99	98	98	98	98	98	99	99	99	98	99	99	99	99	99	99	99	98	99
15	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
16	99	98	98	98	98	98	99	99	99	99	99	99	99	99	99	99	99	99	99
17	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
18	98	98	98	98	98	98	99	99	99	99	99	98	99	99	99	99	99	98	99
19	99	99	99	99	99	99	98	98	98	98	98	98	98	98	99	99	99	99	99
20	99	99	99	99	99	99	99	99	99	98	99	98	99	99	99	99	98	99	98
21	99	99	99	99	99	99	98	98	98	98	98	98	98	98	99	99	99	98	99
22	99	99	99	99	99	99	99	99	99	98	99	99	99	98	99	99	99	98	98
23	98	98	98	98	98	98	98	98	98	98	98	98	98	99	99	99	99	99	99
24	98	98	98	98	98	98	99	99	99	99	99	99	99	98	99	99	99	99	98
25	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98

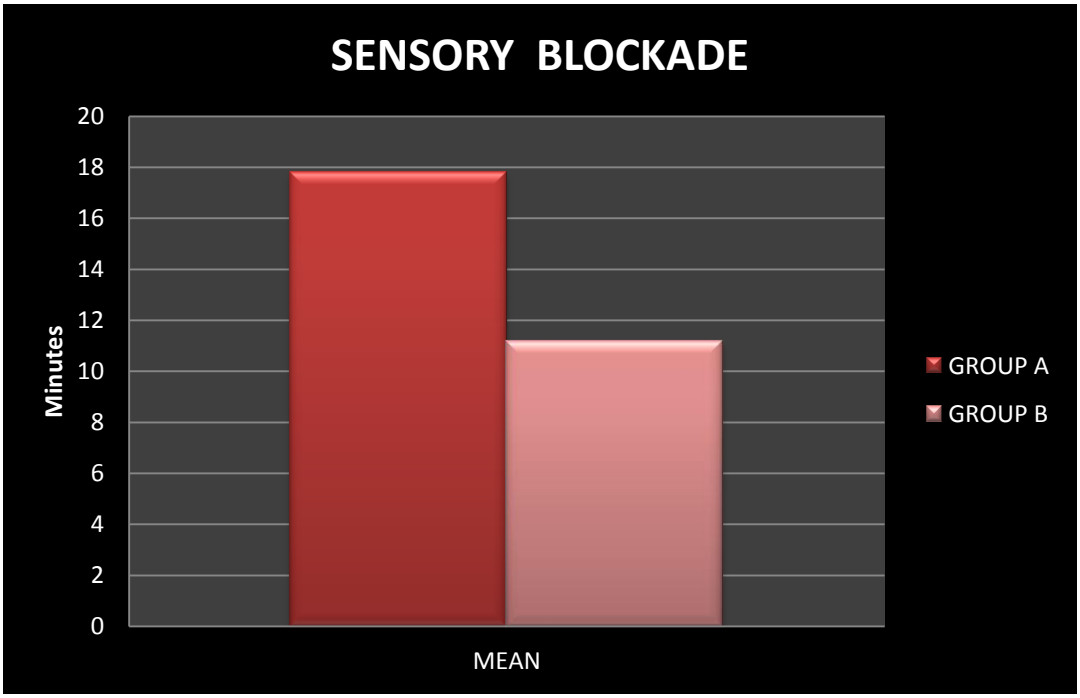
S.NO.	SPO2 % (GROUP B)																		
	BASE LINE	5 MINS	10 MINS	15 MINS	20 MINS	25 MINS	30 MINS	35 MINS	40 MINS	45 MINS	50 MINS	55 MINS	60 MINS	65 MINS	70 MINS	75 MINS	80 MINS	85MINS	90 MINS
1	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
2	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
3	99	99	99	98	99	99	99	99	99	99	99	99	98	98	99	99	98	99	99
4	99	99	99	97	99	99	99	98	99	99	99	98	98	99	99	99	99	99	99
5	99	99	99	98	99	99	99	98	99	99	97	99	97	98	99	99	98	99	99
6	99	98	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
7	98	97	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
8	99	98	99	99	99	99	98	99	99	99	98	99	99	99	99	98	99	99	98
9	99	97	99	99	99	99	99	97	99	97	99	99	99	99	99	99	98	99	99
10	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
11	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
12	99	98	99	98	99	99	97	98	99	99	98	98	98	99	99	99	99	99	99
13	99	99	99	99	99	99	99	98	99	98	98	99	99	98	99	98	98	99	98
14	99	99	99	99	99	99	99	98	99	98	97	99	98	99	99	99	99	99	99
15	99	99	99	99	99	99	98	99	99	99	99	99	99	99	99	98	99	99	98
16	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
17	98	98	98	97	98	98	97	98	98	98	98	98	98	98	98	98	98	98	98
18	99	99	99	99	99	99	99	99	99	98	99	99	99	99	99	99	99	99	99
19	99	98	99	98	99	99	99	99	99	99	98	99	98	99	98	98	99	99	98
20	98	97	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
21	98	98	98	98	98	98	99	98	98	98	98	98	98	98	98	98	98	98	98
22	99	97	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99
23	99	99	99	99	99	99	99	99	99	99	97	99	99	99	99	99	99	99	99
24	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98	98
25	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99	99

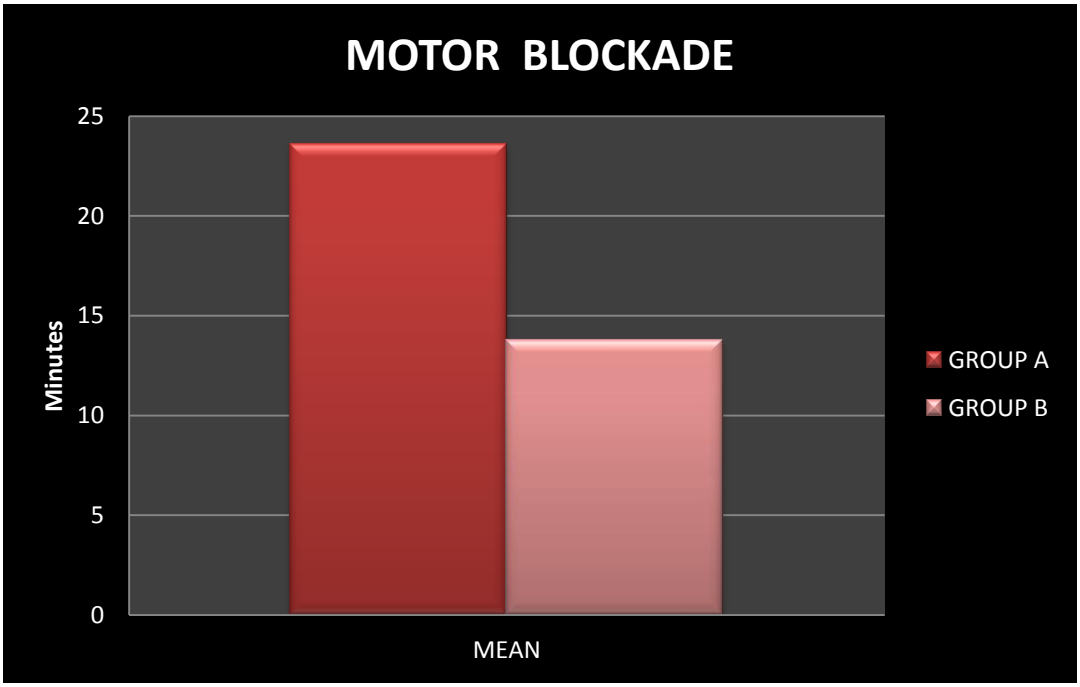

AGE
50
40
30
20
10
0
years
Mean
GROUP A
GROUP B


SEX
25
20
15
10
5
0
No. Of Patients
MALE
FEMALE
GROUP A
GROUP B

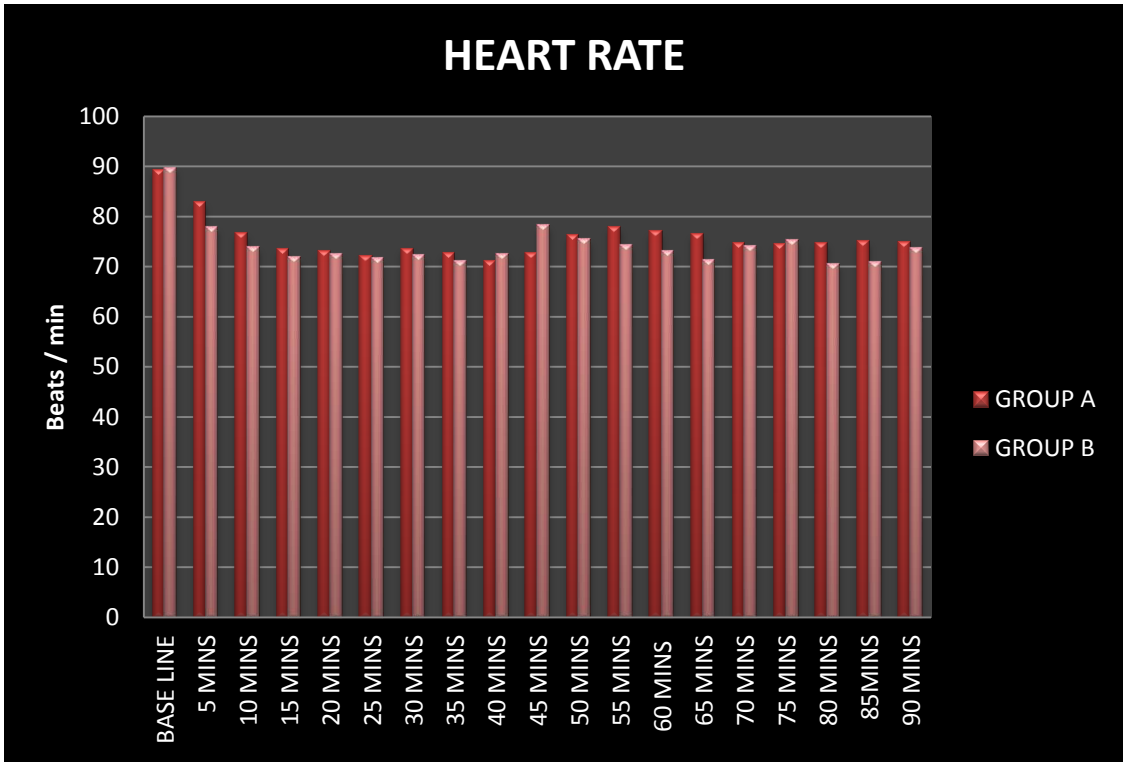

BODY MASS INDEX
30
25
20
15
10
5
0
Kg/m²
Mean
GROUP A
GROUP B

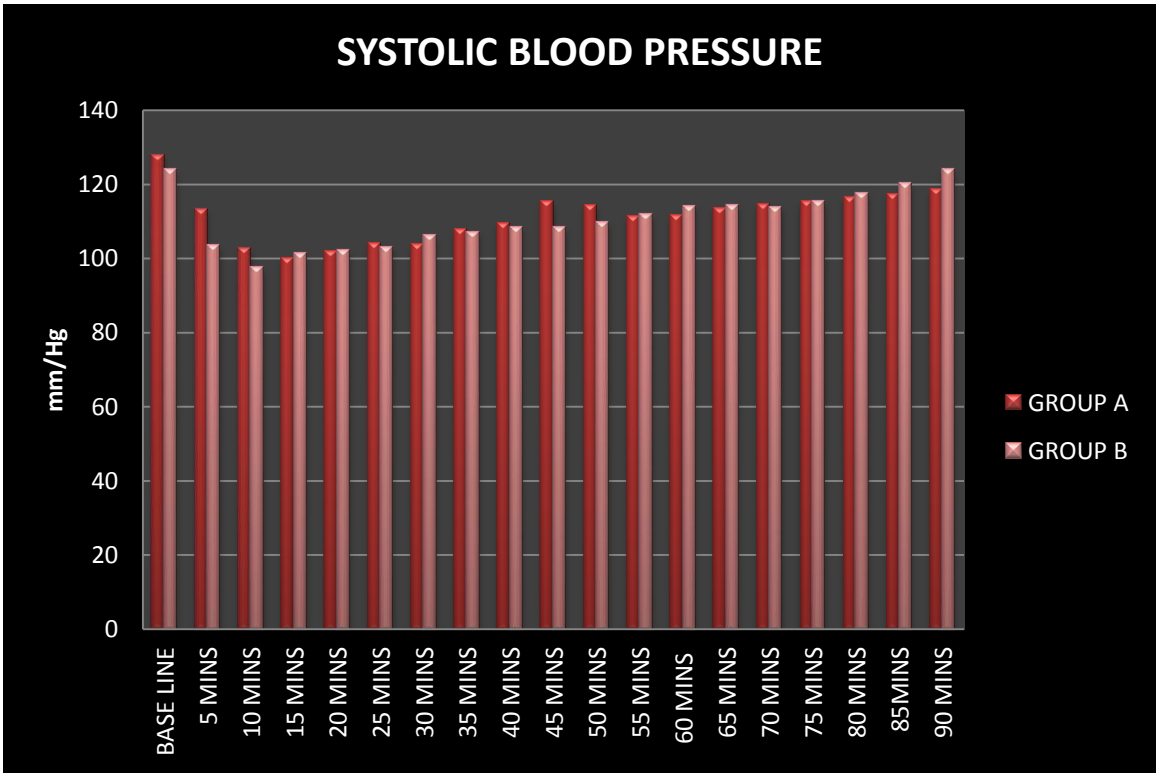

ASA PS STATUS
30
25
20
15
10
5
0
No. Of Patients
ASA I
ASA II
GROUP A
GROUP B

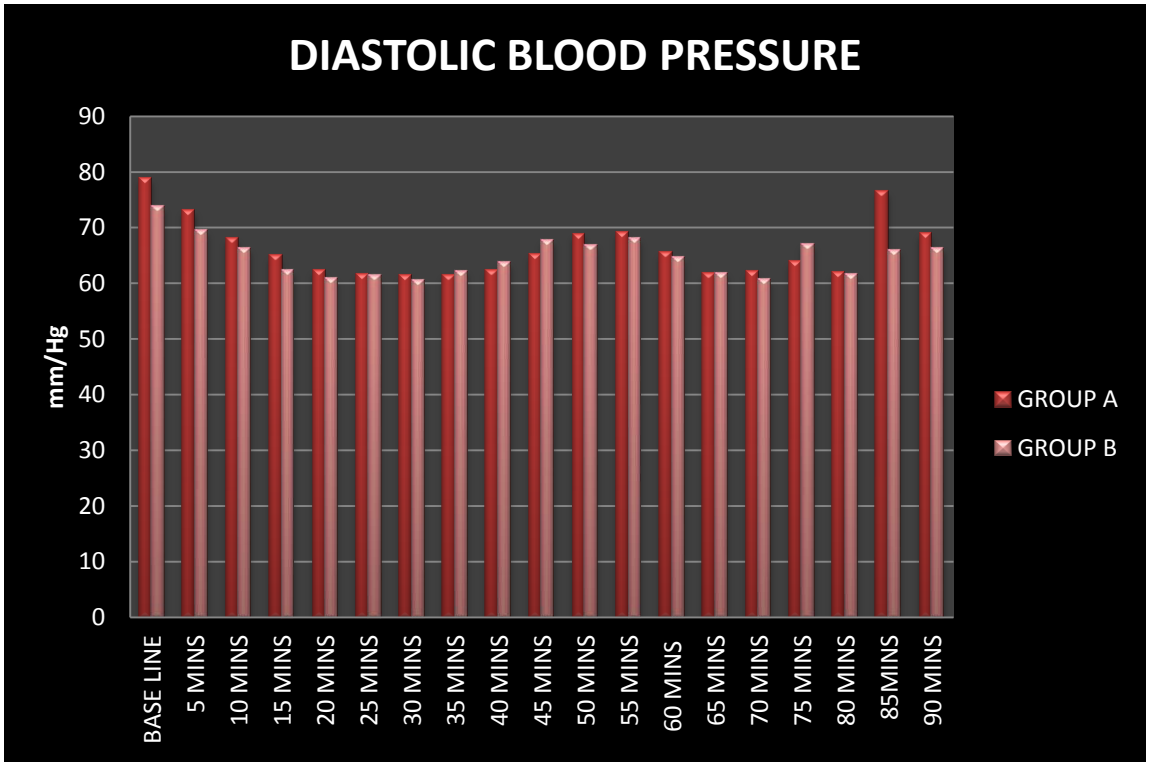

SENSORY BLOCKADE
Minutes
20
18
16
14
12
10
8
6
4
2
0
MEAN
GROUP A
GROUP B

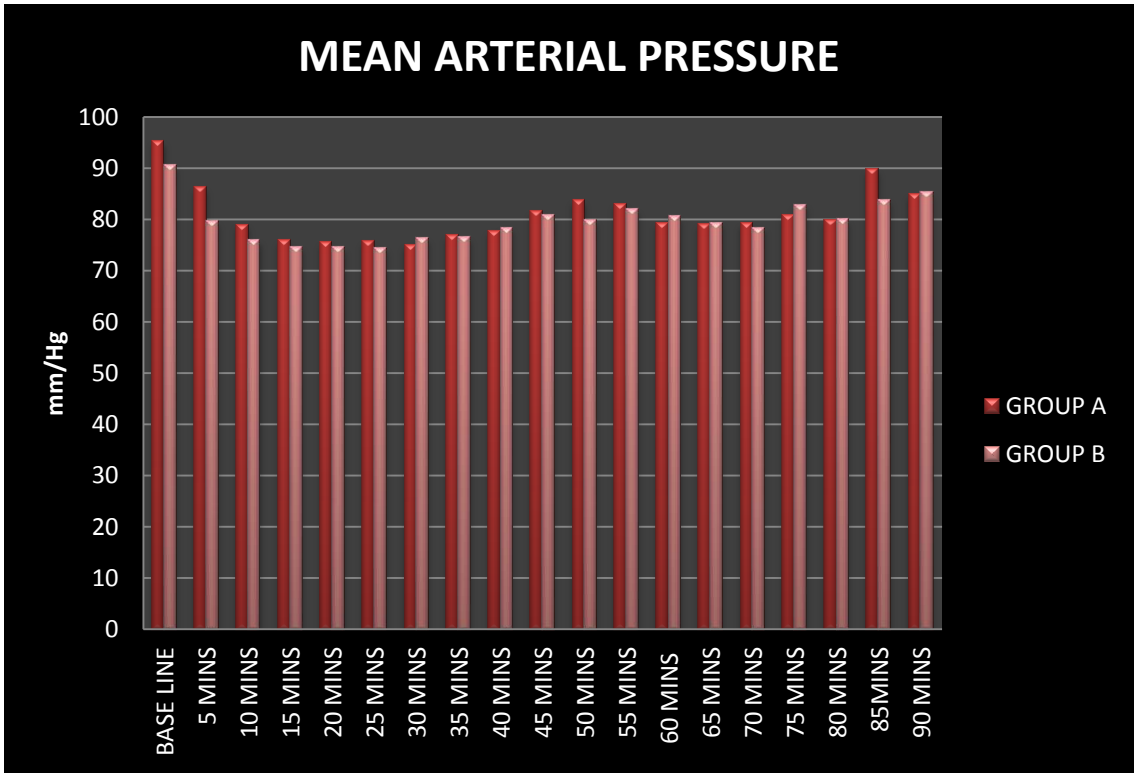

MOTOR BLOCKADE
Minutes
25
20
15
10
5
0
MEAN
GROUP A
GROUP B

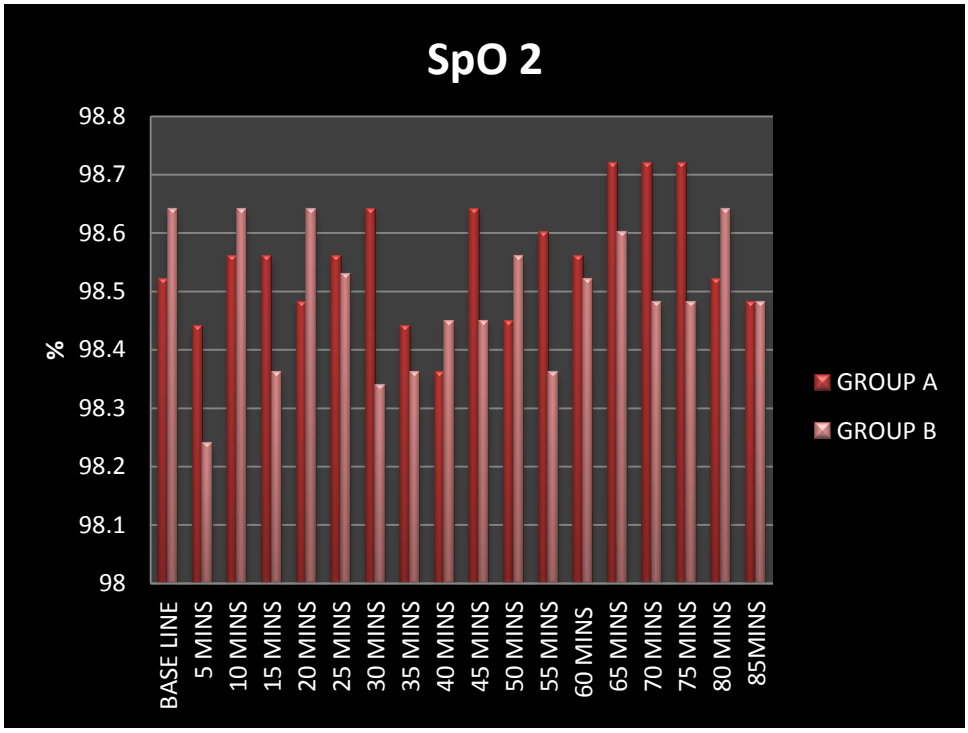

TWO SEGMENT REGRESSION
90
80
70
60
50
40
30
20
10
0
Minutes
MEAN
GROUP A
GROUP B

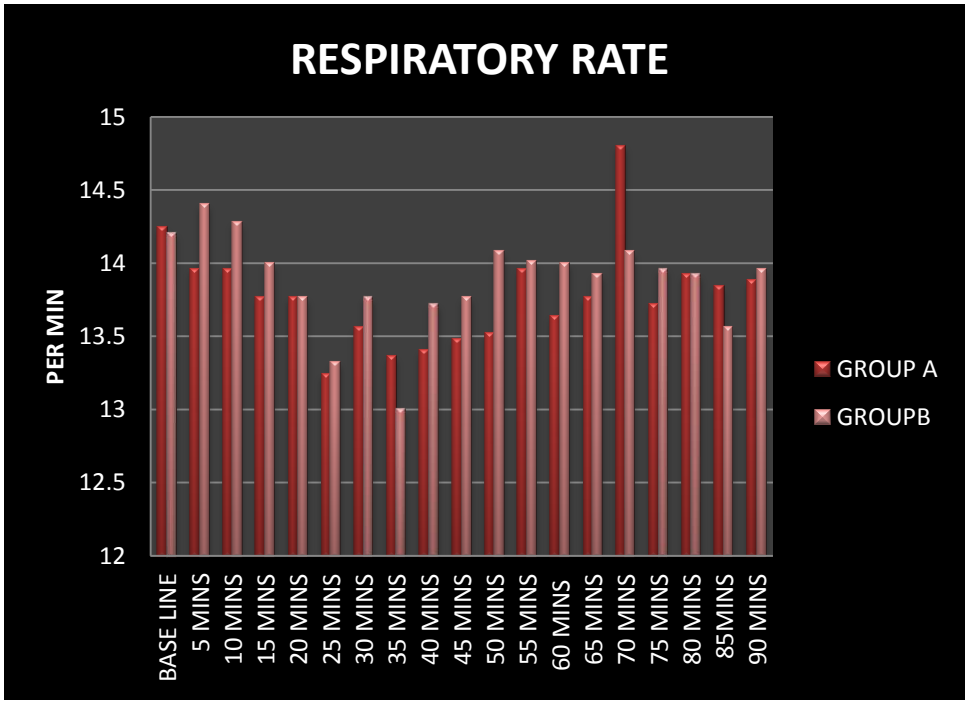

HEART RATE
Beats / min
100
90
80
70
60
50
40
30
20
10
0
BASE LINE
5 MINS
10 MINS
15 MINS
20 MINS
25 MINS
30 MINS
35 MINS
40 MINS
45 MINS
50 MINS
55 MINS
60 MINS
65 MINS
70 MINS
75 MINS
80 MINS
85MINS
90 MINS
GROUP A
GROUP B

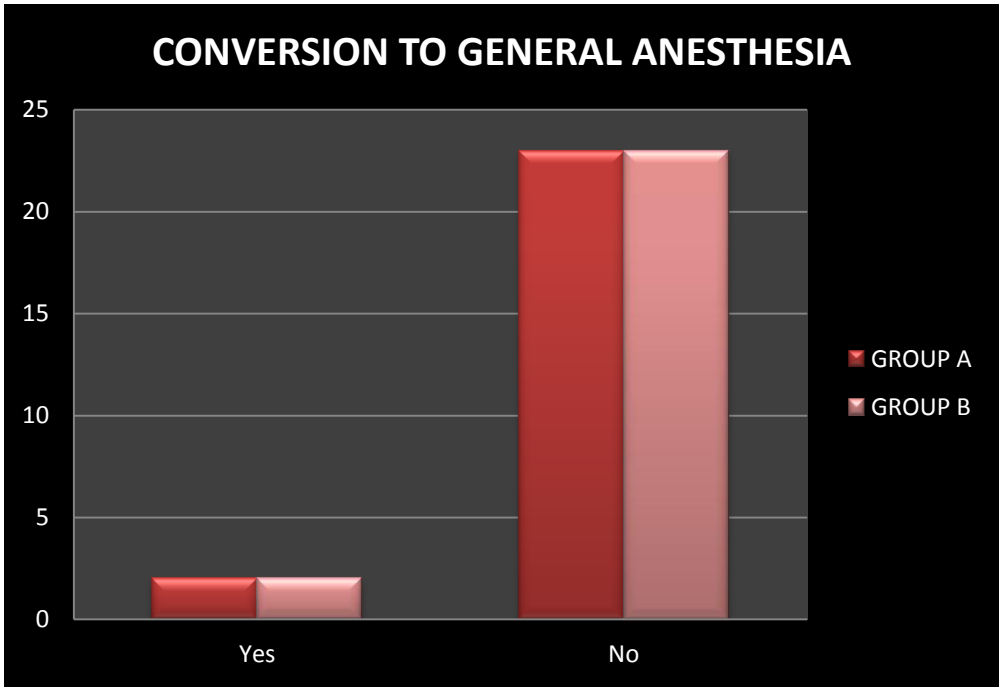

SYSTOLIC BLOOD PRESSURE
mm/Hg
140
120
100
80
60
40
20
0
BASE LINE
5 MINS
10 MINS
15 MINS
20 MINS
25 MINS
30 MINS
35 MINS
40 MINS
45 MINS
50 MINS
55 MINS
60 MINS
65 MINS
70 MINS
75 MINS
80 MINS
85MINS
90 MINS
GROUP A
GROUP B

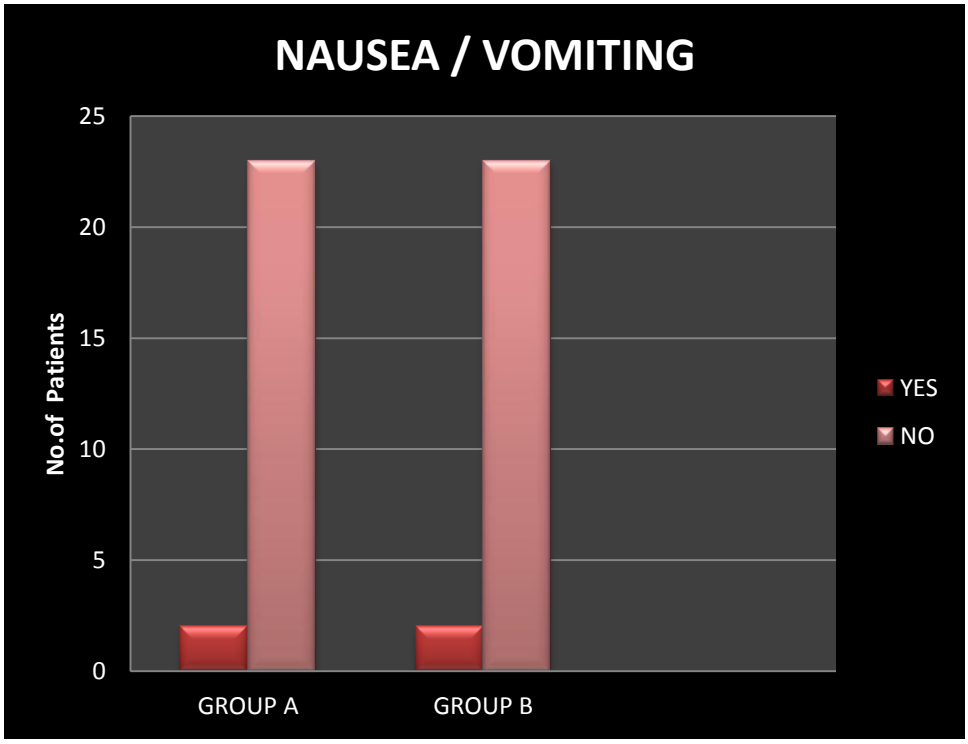

DIASTOLIC BLOOD PRESSURE
mm/Hg
90
80
70
60
50
40
30
20
10
0
BASE LINE
5 MINS
10 MINS
15 MINS
20 MINS
25 MINS
30 MINS
35 MINS
40 MINS
45 MINS
50 MINS
55 MINS
60 MINS
65 MINS
70 MINS
75 MINS
80 MINS
85MINS
90 MINS
GROUP A
GROUP B

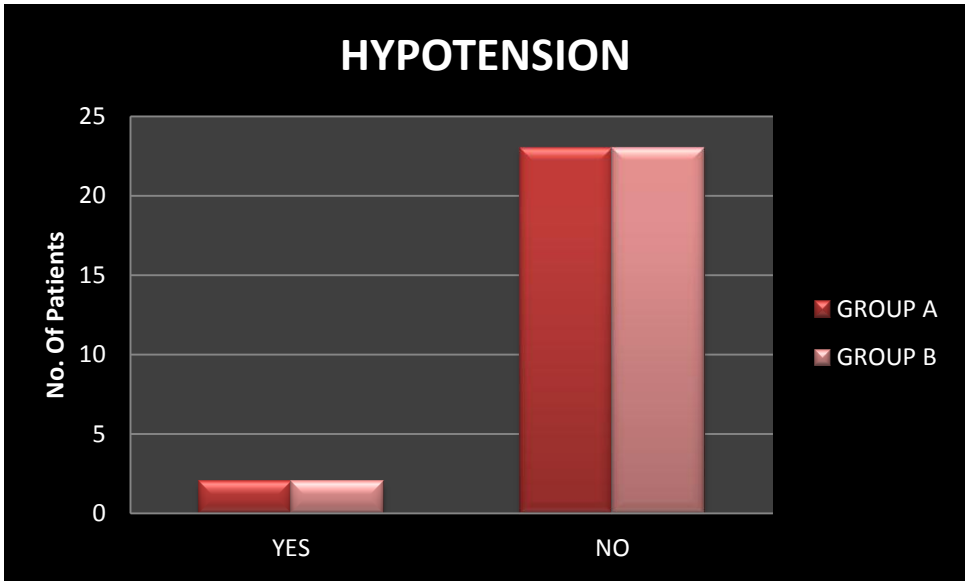

MEAN ARTERIAL PRESSURE
mm/Hg
100
90
80
70
60
50
40
30
20
10
0
BASE LINE
5 MINS
10 MINS
15 MINS
20 MINS
25 MINS
30 MINS
35 MINS
40 MINS
45 MINS
50 MINS
55 MINS
60 MINS
65 MINS
70 MINS
75 MINS
80 MINS
85MINS
90 MINS
GROUP A
GROUP B

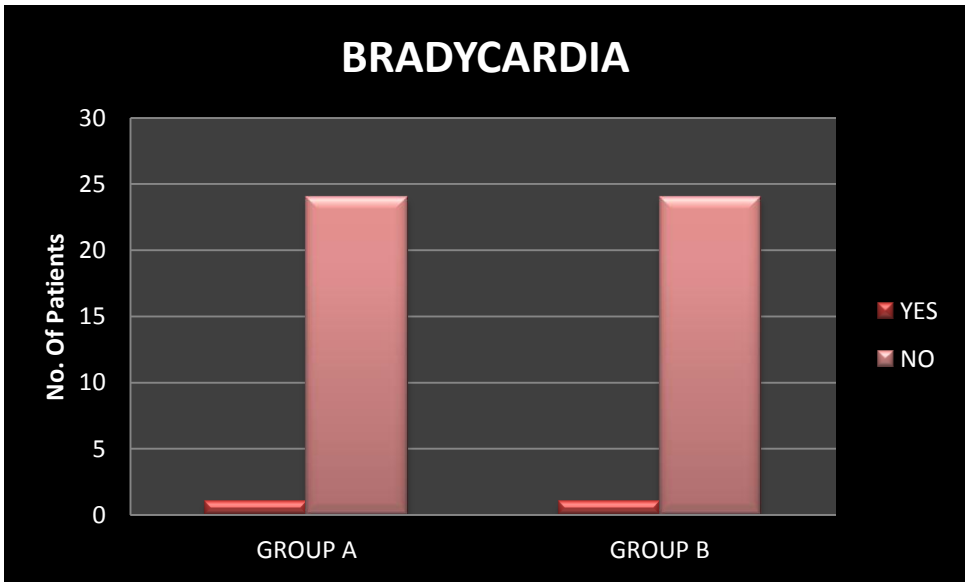

SpO 2
98.8
98.7
98.6
98.5
98.4
98.3
98.2
98.1
98
%
BASE LINE
5 MINS
10 MINS
15 MINS
20 MINS
25 MINS
30 MINS
35 MINS
40 MINS
45 MINS
50 MINS
55 MINS
60 MINS
65 MINS
70 MINS
75 MINS
80 MINS
85MINS
GROUP A
GROUP B

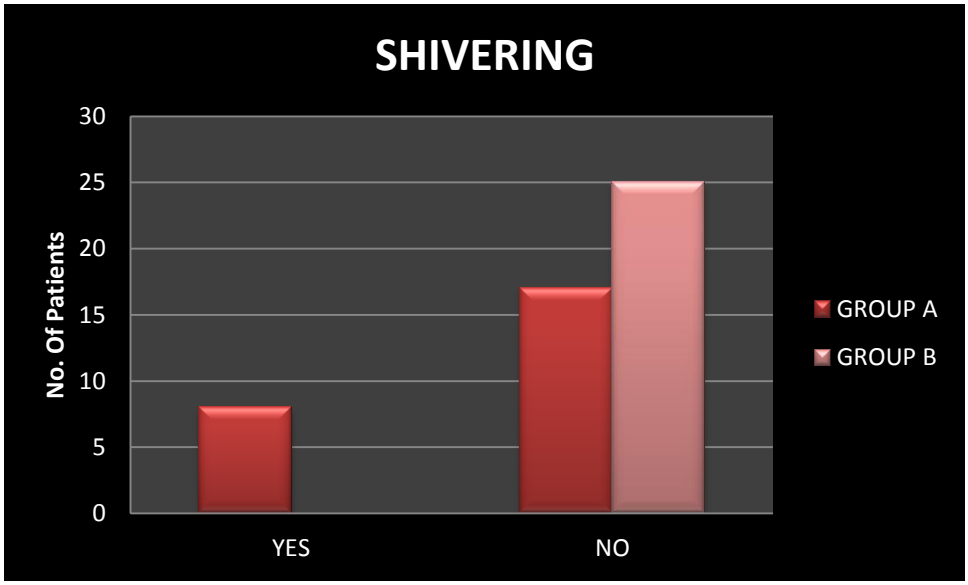

RESPIRATORY RATE
15
14.5
14
13.5
13
12.5
12
PER MIN
BASE LINE
5 MINS
10 MINS
15 MINS
20 MINS
25 MINS
30 MINS
35 MINS
40 MINS
45 MINS
50 MINS
55 MINS
60 MINS
65 MINS
70 MINS
75 MINS
80 MINS
85MINS
90 MINS
GROUP A
GROUPB

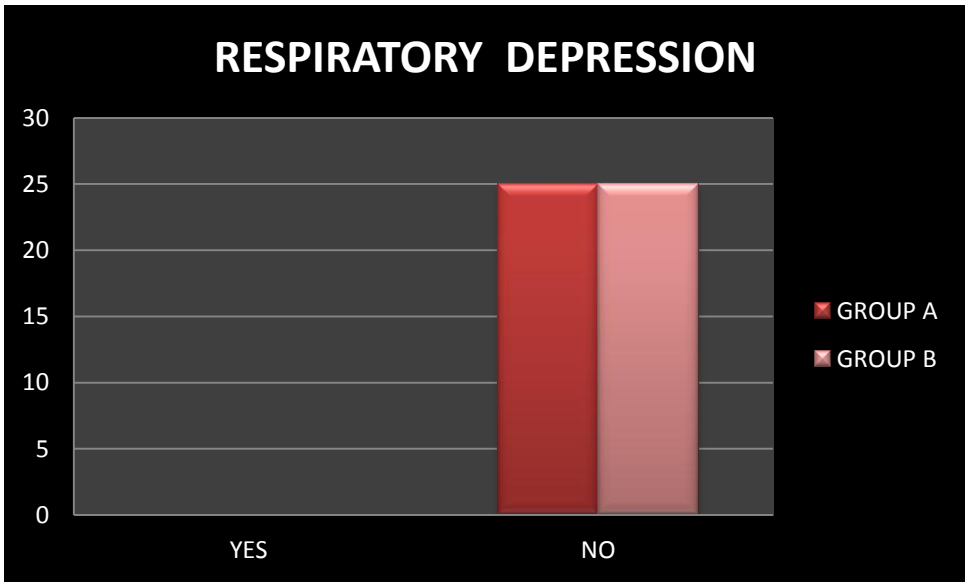

CONVERSION TO GENERAL ANESTHESIA
25
20
15
10
5
0
Yes
No
GROUP A
GROUP B


NAUSEA / VOMITING
No.of Patients
25
20
15
10
5
0
GROUP A
GROUP B
YES
NO


HYPOTENSION
No. Of Patients
25
20
15
10
5
0
YES
NO
GROUP A
GROUP B


BRADYCARDIA
No. Of Patients
30
25
20
15
10
5
0
GROUP A
GROUP B
YES
NO


SHIVERING
No. Of Patients
30
25
20
15
10
5
0
YES
NO
GROUP A
GROUP B


RESPIRATORY DEPRESSION
30
25
20
15
10
5
0
YES
NO
GROUP A
GROUP B

A STUDY TO EVALUATE MAGNESIUM SULPHATE IN ACCELERATING THE ONSET OF ACTION OF INJECTION BUPIVACAINE USED FOR EPIDURAL ANAESTHESIA

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co-authors : *Prof.T.Venkatachalam, , Institute of Anaesthesiology and Critical Care, Madras Medical College , Chennai.*

ABSTRACT

OBJECTIVE: To evaluate the effect of onset of action of magnesium sulphate in epidural anesthesia in patients coming for elective lower abdominal surgeries.

METHOD: After institutional ethical committee clearance this prospective randomised double blinded study was undertaken to establish the effect of addition of magnesium as an adjuvant to epidural bupivacaine in lower abdominal surgeries. A total of 50 American Society of Anaesthesiology (ASA) grade I & II patients undergoing lower abdominal surgeries were enrolled to receive either magnesium sulphate (B) or 0.9 % Normal saline (A) along with epidural bupivacaine for surgical anaesthesia. All patients received 14 ml of epidural bupivacaine 0.5% along with 50 mg(1 ml) magnesium in group B, 0.9 % Normal saline (1 ml) in group A . Onset time ,heart rate, blood pressure, duration of analgesia, pain, assessment by visual analog score (VAS), RAM score and adverse effects were recorded.

RESULTS: Onset time of sensory blockade was rapid in magnesium group compared to the control group (11.20±2.17 vs 17.80±2.53, respectively). The time for two segment motor regression 84.00 ± 7.5 in the magnesium group and 51.00 ± 7.50 in the control group with a p value of <0.001 The groups were similar with respect to hemodynamic variables.

CONCLUSION: The current study establishes magnesium sulphate as a predictable adjunct to epidural bupivacaine for rapid onset of anaesthesia with no adverse effects.

Key words: Bupivacaine, epidural anesthesia, Magnesium sulphate